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BEFORE THE HOUSE RESOURCES COMMITTEE

SUBCOMMITTEE ON FISHERIES CONSERVATION, WILDLIFE, AND OCEANS, AND

SUBCOMMITTEE ON NATIONAL PARKS, RECREATION, AND PUBLIC LANDS

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Mr. Chairman and Members of the Committee:

Thank you for the opportunity to present testimony today on invasive alien species problems in Hawaii and the Pacific.

I am Dr. Fred Kraus and am employed as a research scientist with the Bishop Museum in Honolulu. I have been involved with research and/or control work with invasive alien species since 1991, when I initiated and implemented control work for feral ungulates and invasive plants on a privately owned island in the British Virgin Islands. From 1996 to 2001, I worked on a large variety of invasive-species policy and programmatic efforts for the Hawaii Department of Land and Natural Resources and was active in coordinating a number of inter-agency coalitions dedicated to addressing various aspects of the invasive-species problem in Hawaii. For the past two years I have worked for the Bishop Museum and have continued research into problems involving alien vertebrates.

The uniqueness of Hawaii and other Pacific islands lies in their isolation from continental landmasses and their great topographic and climatic diversity. As a result, natural colonization of these islands has been very infrequent and has often led to the generation of species unique to particular islands and archipelagos. In the case of Hawaii, this isolation has resulted in the evolution of approximately 10,000 species found nowhere else on Earth, out of a total biota of approximately 18,000 native species. Topographic and soil variability have also resulted in a mix of habitats that can place tropical rainforests within a few miles of baked desert-like conditions, creating climatological transects that would occur over much greater distances in continental situations. For these reasons, Hawaii holds a significant portion of the United States' patrimony of biological wealth.

However, with the breaking of natural geographic isolation by human activities, these native biota and ecosystems have been overwhelmed by the establishment of more than 5000 species of alien plants and animals in Hawaii in the past 200 years. This represents a rate of successful colonization of new species that is more than one million times the natural rate. This pattern shows no sign of abatement, and in the past five years, the Hawaii Biological Survey has documented an average of 177 additional alien species in Hawaii each year. Under these circumstances Hawaii's ecological meltdown is not unexpected and can be represented in a number of ways. As one example, Hawaii has lost hundreds of species to extinction, currently has 322 species recognized as endangered or threatened by the USFWS (26% of the U.S. total), and has hundreds more that are deserving of protection but unlisted. In this latter category, at least 50 species have populations smaller than 50 known individuals. Virtually all of these endangered species, except for the marine forms, are endangered primarily or in large part by invasive aliens. Alternatively, if one looks at the landscape scale, Hawaii has lost a massive percentage of its native habitats (Fig. 1). The large majority of this habitat loss is due to replacement of native vegetation by invasive plants - often mediated by past human habitat clearance - or due to total removal of native plant cover by alien ungulates, leaving large expanses of bare soil. Losses elsewhere in the Pacific are frequently in the same range, although some islands have fared better. Economic effects of invasives have been poorly quantified in the Pacific but losses greater than $150 million/yr are ascribed to one species of termite in Hawaii alone and economic and

health costs of brown treesnakes in Guam have been discussed, and Hawaii's agriculture has been buffeted by a succession of alien pests. Despite this lack of research, economic costs of invasives in the Pacific are likely to be large in many cases.

No well-researched effort has been undertaken to address the question, but a reasonable estimate is that approximately 300-500 of Hawaii's 5200 established alien species are ecologicalyl damaging. This includes approximately 20-40 vertebrates, 150-200 plants, and an unknown, but large, number of invertebrates and pathogens. Areas invaded by individual species range from a few acres to hundreds of thousands of acres and the damage created by them spans a similar continuum, with the most damaging forms including many with the largest ranges. Generally, taxa that are able to alter ecosystem function or community structure have been especially detrimental, and prominent examples across the Pacific include trees, grasses, feral ungulates, mammalian predators, rats, and social insects like ants and wasps. These species are especially notorious because their effects are often so great as to be obvious to large segments of society. As just one example among many, the Neotropical tree Miconia calvescens has spread to cover two-thirds of Tahiti's forests in the past 70 years. As a result, landslides have become more common, watershed values are degraded, and 40-50 species now face extinction. This tree has large populations on the islands of Maui and Hawaii and threatens to inflict similar damage there should control efforts falter. Similar examples from the Pacific could be multiplied to the point of tedium but I will eschew that exercise. It is critical to remember, however, that not all damage is created by well-known villains. As one example, the brown treesnake, now widely recognized as the reason for Guam's near-total loss of native forest birds, was originally rejected by many as the cause of this loss because few could imagine a mere snake having such devastating ecological consequences. Similarly, concerns raised in 1997 that coqui frogs would create problems in Hawaii were greeted with derision; however, these same problems have blossomed and received national media attention in the past few years. In many cases, ecological degradation in the Pacific results not from just one or a few key species but from the "death by a thousand cuts" inflicted by the composite magnitude of the invasion.

The species comprising the alien invasion arrive through a variety of pathways, but this variety may be grouped into two major categories: intentional and unintentional introductions. Examples of the former include released pets, garden escapes, and biocontrol organisms; examples of the latter include hull-fouling organisms, ballast water, and seed contaminants. The important point to note is that pathway importance varies by taxon. Some groups, such as fish, mammals, birds, and vascular plants, are primarily introduced purposely because someone perceives a value for the species. Others, such as marine algae, landsnails, insects, and pathogens are usually unintentional, and unwanted, introductions. Efforts to address invasive-species problems often focus on only one or a few pathways but a comprehensive program will require that all important pathways be addressed.

A number of factors has limited the effectiveness of our responses to invasive aliens in Hawaii and across the Pacific. A few of these, such as rugged terrain and small tax bases, are inherent to the region and cannot be changed. But most historical limitations are theoretically correctable by human action. One of the greatest current shortfalls in invasive-species programs in Hawaii is lack of dedicated personnel to do the work. Consequently, otherwise promising initiatives against invasives continually founder for lack of personnel to carry out the tasks. Responsibilities for invasives are often divided among a number of agencies, often saddling agencies with insufficient authorities and making response coordination among agencies unused to cooperation difficult. For example, within the State of Hawaii, responsibility for border inspection and quarantine lies with the Hawaii Department of Agriculture; responsibility for controlling infestations on State lands lies with the Department of Land and Natural Resources. But no agency has authority over most pests in the urban interface or other private lands, where most alien invasions begin. Hence, by the time invasions progress to State lands it is usually too late to implement effective control. Identical problems plague the federal agencies. In many cases, even when these hurdles have been overcome, we lack the requisite ecological or control-methodology knowledge to respond effectively. There are a large number of invasive species for which we lack even basic knowledge of their biological susceptibilities or potentially effective control methods. This includes most marine invertebrates, many plants, and a wide array of vertebrates. Furthermore, when successful cooperative inter-agency control or prevention programs have been implemented, such as the brown treesnake control program in Guam, CNMI, and Hawaii, there has been a failure to learn from these successes and systematize their approaches to address other invasive pest problems. For example, fire ants and West Nile virus are poised to invade the Pacific. The success of the brown treesnake interdiction program could serve as a model for proactively stopping the spread of these pests before they arrive in the Pacific but the opportunity is not being grasped.

Finally, one severe limitation is unique to Hawaii and the Pacific and that is the failure of mainland policy-makers to recognize the biological uniqueness and heightened susceptibility of this region to pests that are no cause for concern on the mainland. As a result, Hawaii has often received via the mainland U.S. severely damaging pests that the USDA refused to prohibit U.S. entry because the pests were tropical in nature and would not affect mainland interests. Under these circumstances, it is a simple matter for a tropical country to ship goods to the mainland for immediate reshipment to Hawaii -- goods that if shipped directly to Hawaii would be barred entry by the State. This practice has made Hawaii especially liable to decisions appropriate for temperate decision-makers but irrelevant to our tropical situation. And invasion in Hawaii often leads to pest expansion farther west in the Pacific because Hawaii serves as the economic gateway for much of the region.

To stem the flood of invasive species, a multi-tiered approach to prevention and control must be implemented so as to capitalize on the multiplicative protection afforded by each component. Obviously, the most effective and efficient means of mitigating additional alien-species problems is to prevent their introduction in the first place. Hence, comprehensive quarantine and screening systems should form the foundation for any alien-species mitigation program. Should alien pest species breach the quarantine barrier, the most cost-effective means of mitigation is to discover and eradicate newly established alien species prior to population entrenchment. If successful, this avoids the large costs of perpetual control. Lastly, for those species that have become firmly established, long-term control to mitigate their worst effects is usually the only remaining option, but this is typically expensive and must occur in perpetuity to be effective. Each of these approaches ideally should be coordinated with the others to provide a functional system of protections. Progress has been made in each of these areas in the Pacific region although successful programs have been somewhat ad hoc and are not yet united to form a comprehensive system of protection at any one locality, except in New Zealand and, to a lesser extent, Australia.

Prevention includes both quarantine efforts to intercept hitch-hiking pests in cargo and packing materials as well as screening systems to evaluate the potential invasiveness of species proposed for intentional introduction. The USDA's long-standing inspection service at designated ports of entry illustrates one partially successful means of conducting a quarantine program, although that program suffers from a narrow focus on only agricultural pests. The same agency's quarantine and inspection program protecting California agriculture from alien fruit flies invasive in Hawaii is a model of how effective protection may be afforded by a comprehensive inspection program. In this program, all passengers flying from Hawaii to the U.S. mainland must have their luggage screened by X-ray machines and certified free of produce. This has kept California relatively free of three species of pestiferous fruit flies for a number of years. A reciprocal program is needed, however, to protect Hawaii from the host of invasive aliens it receives from the U.S. mainland.

The most effective screening system yet developed to halt the intentional spread of invasive aliens is the Weed Risk Assessment devised by the Australian Quarantine and Inspection Service. This quick, transparent evaluation system has been used successfully in that country and in New Zealand to exclude importation of invasive plants for the past several years. Preliminary tests have shown its efficacy at predicting invasiveness of alien plants in Hawaii and Fiji too and efforts are underway in Hawaii to get a modification of this system implemented on a voluntary basis to reduce the rate of importation of new invasive species.

There has been success in Hawaii at implementing some level of rapid-response protection that involves the formation, on each major island, of a coalition of interested agency and non-governmental personnel dedicated to removing incipient populations of known invasive species before they become well-established and ineradicable. These so-called invasive species committees have had considerable success in reducing or eradicating an array of invasive species (mostly plants) but efforts to date cannot be viewed as comprehensive because of the large standing crop of incipient invasives in Hawaii. Cessation of control activities for even a short period could negate many of the gains made in recent years. These committees also serve as successful local models of cooperation among a variety of agency and private partners to address the invasive-species threat in Hawaii. The same is true for the Coordinating Group on Alien Pest Species (CGAPS), which serves to coordinate policy actions at a statewide scale, again involving a wide array of government and non-governmental parties.

Perhaps the most successful example of an integrated prevention/rapid-response/research system protecting Hawaii and the Pacific is the inter-agency brown treesnake prevention program based on Guam and its supportive research program based in Fort Collins, Colorado. This program consists of

comprehensive inspection on Guam of outbound cargo and vessels and population reduction of snake populations in port areas. Since implementation in 1995, the incidence of brown treesnake appearance in other jurisdictions has declined dramatically. This program could serve as a model for other species-specific prevention programs throughout the Pacific but despite its demonstrable success it continues to struggle for year-to-year funding, making its long-term stability uncertain. Despite this lack of base funding, this program does indicate one direction that a comprehensive, coordinated response to other invasive-species threats could successfully take.

For the large number of invasive species that are already widespread and wreaking ecological havoc in Hawaii, the best model for long-term mitigation has been provided by the National Park Service. Through efforts extending over the past two decades or so, park managers have removed or seriously reduced several of the most destructive invasive pests -- including ungulates, mammalian predators, and a wide array of plants -- over large areas of Haleakala and Hawaii Volcanoes National Parks. These efforts have served as models used by other agencies in Hawaii and elsewhere in the Pacific. However, these impressive gains may be mooted in the future if the current trends in alien invasion convert these parks to postage stamps of native habitat with an ever-larger tide of invasives lapping at their borders. In this respect, should miconia, brown treesnakes, fire ants, West Nile virus, or other especially severe invasives arrive at park boundaries, there would be little hope of sustaining natural resource values within the parks themselves. In recognition of this, it makes sense for natural resource agencies to become more proactive in addressing invasive species threats before they reach their lands.

Despite these successes, efforts to address invasive-species threats in Hawaii and the Pacific in a comprehensive fashion are still in the early stages of development and it is clear from experience that a number of unsuccessful approaches to the problem need to be avoided. First, it is clear that adoption of a "black list" approach that bars entry to a handful of species deemed especially harmful (an approach taken by the federal Lacey Act) is doomed to failure. This is because it is impossible to evaluate and list more than a small percentage of the millions of species estimated to inhabit the planet, so large numbers of invasives will always pass through a screen having such large holes. More importantly, the irreversible nature of alien-species invasions logically necessitates adoption of the precautionary principle in order to successfully meet a reasonable standard of risk-aversion. A black list approach does just the opposite, allowing entry to any species unless demonstrably shown to be harmful. The problem with this approach, of course, is that it logically requires that an ecological disaster be in place before action is taken. The screening systems used in Australia and New Zealand have successfully taken the opposite approach. Second, eradication efforts that fail to secure long-term support to ensure completion of the action should not be undertaken. Numerous attempts at eradicating incipient pests have failed because of underestimation of population resiliency and consequent under-commitment of needed resources. The effort to control miconia in Hawaii could easily meet this same fate. Third, the historically piecemeal approach taken by federal and state governments in the U.S., with authorities uncoordinated among a diversity of agencies, cannot successfully meet the challenges posed by the magnitude of the invasive-species problems in this country. In Hawaii, we have had some success in achieving better coordination among this host of agencies but it is not clear if that alone will be sufficient to meet the challenge. Serious consideration needs to be given to the idea of unifying all invasive-species prevention and control efforts under a single biosecurity agency. Lastly, the costs of allowing invasive species into the U.S. have, in most instances, been externalized across society. These costs need to be internalized so that those who benefit by the importation activities have incentives to reduce the danger of the activities by which they benefit. The invasive-species problem is of such magnitude that government action alone, without adoption of some market incentives, will be insufficient to provide a complete solution.

Resources needed to protect Hawaii and the Pacific from further invasive-species incursions largely fall into the categories of increased capacities and increased authorities. Capacity needs for prevention, rapid-response, and long-term control of invasive species in Hawaii were comprehensively estimated by CGAPS two years ago to be $53 million/yr in State funds (Table 1). Current total State spending is perhaps 10% of that. Improving federal roles in quarantine inspection, research, and control would add several tens of millions of dollars to this figure. Hawaii and the Pacific need a federal quarantine program -- reciprocal to that provided the mainland -- to protect these islands from mainland goods and passengers, which have been the source of innumerable invasive pests over the years. For preventing intentional introduction of invasives, we need functional plant-screening systems in place as well as research to develop similar screening systems for animals. To provide for effective early-detection and rapid-response programs we need expanded authorities to facilitate operations on private lands and the ability to tap contingency funds to eradicate pests before they explode in numbers. For this and long-term control programs we also need

considerably more research into developing effective control methodologies.

In meeting these requirements, it is important to emphasize that money spent earlier in the invasion process is more cost-effective than that spent later. Hence, priority should be given to establishing effective prevention programs that involve inspection and quarantine for unintentional introductions and screening systems for intentional introductions. These prevention programs should abandon the black-list approach for a more proactive white-list approach and should internalize programmatic costs to those benefiting from the importation activity.

Thank you, Mr. Chairman and Members of the Committee.