TESTIMONY OF CELIA SMITH

BEFORE THE
US HOUSE OF REPRESENTATIVES, COMMITTEE ON RESOURCES,
SUBCOMMITTEE ON FISHERIES CONSERVATION, WILDLIFE AND OCEANS

April 15, 2004

REGARDING THE IMPACTS OF MARINE INVASIVE ALGAE.

Good morning Chairman Gilchrest and distinguished members of the Subcommittee on Fisheries Conservation, Wildlife and Oceans. I am Celia M. Smith, Professor of Botany at the University of Hawai'i. With my testimony today, I'd like to set the stage to help you realize the significant impacts of invasive and alien algae in the Hawaiian archipelago, following on the comments made by my colleague Dr. Steve Coles for invertebrate animals. Thank you for this opportunity to outline mechanisms and threats associated with these invasive algae.

Through several research activities, we know that the Hawaiian marine flora, the algae or limu as they are known to Hawaiians, represent a diverse flora rivaling the complexity of any other tropical locale. This complexity arises in part from our isolation as well as habitat complexity and biological diversity. We have world-class sandy beaches (as ranked by "Dr. Beach") punctuated by roughwater intertidal regions along stretches of coastline; these algal communities extend quite deep, into nutrient rich waters down to 150 m (the quality of ocean water here is clear enough for exceptional light penetration and plant growth to great depths). Few other places in the US have this combination of physical factors or acreage for coral reef regions as found here in Hawai'i.

The complexity of our limu population is also surprising by the number of endemic species found here in the Hawaiian islands - and no where else. Levels of endemism approach 25 % for the macroscopic, easily-collected seaweeds; endemism is at 50 % for our seagrasses. We regularly find new algal genera and easily new species with just conventional field collections. Some of our newest taxa were collected here on this island – arguably the best-known region in the tropical Pacific. At least one endemic species, the green alga Boodleopsis hawaiiensis, now occurs in a single collection locale, but is not considered for listing or protection. Standard research approaches for land plant conservation: placement in botanical gardens, establishment of seed banks or tissue culture are not in place for the conservation of any alga. The only tool at hand is maintenance of healthy reef ecosystems.

At cross-purposes with this need to maintain healthy reef ecosystems are the introductions of non-indigenous reef species for aquaculture research. Such introductions in the past grew plants in open reef cultures with little safeguard to containment, and represent the single most important mechanism for introduction of our most potent non-indigenous algae. Growth of plants in tanks where the seawater system is open to the coast has few safeguards against the unintentional release of spores or fragments that can propagate species. Hopefully, sufficient voice will be given to scientific or ecological concerns surrounding the introduction of a non-indigenous species via the implementation of the new Hawaii Invasive Species Council (HISC), a topic of Athline Clark's comments later in this session.

Non-indigenous species threaten native and endemic coral, algae and seagrasses via overgrowth, these natives are the framework for coral reefs and related coastal regions. At this time, we use single species efforts and work to develop method to control overgrowth of corals by red algae Kappaphycus and Gracilaria, the rapid growth of Hypnea musciformis in coastal Maui waters and the loss of culturally important limu habitat to Acanthophora spicifera. Three of these four were brought to Hawaii for aquaculture purposes; I outline their case studies below.

Impacts of Invasive Algae Using Kappaphycus as a Case Study

In the mid 1970's, Dr. Doty of the Botany Department requested permit(s) and was allowed to legally import three species of the red alga Eucheuma (known now as Kappaphycus) from the Philippines and the

Caribbean to provide materials for aquaculture research. This research was conducted, in part, in open pens on the reef adjacent to Hawaii Institute of Marine Biology in Kaneohe Bay. Water motion in that region was sufficient for parts of the plants to break and be carried off the reef, eventually allowing for the escape of these algae to other regions of Kaneohe Bay. In the period since that inoculation, this complex of species has now spread to the full extent of Kaneohe Bay. In just the last four years, the first sightings of this alga occurred outside of Kaneohe Bay. From studies by two graduate students, Dr. Jennifer Smith and Eric Conklin, we now know that this algal complex overgrows corals relatively rapidly (typical rates of increase in cover are approximately 10 % per month) and leads directly to coral death. Patch reefs in Kane'ohe Bay that were 100 % coral cover have changed in as little as 3 years to 100 % algal cover (and coral mortality). Our ecological studies show clear robust trends of loss of species diversity as Kappaphycus biomass increases; in regions where 6 to 7 kg wet weight m-2 is abundant productivity by native species, coral patch reefs in Kaneohe Bay bear the burden of up to 30 kg wet weight of this alga m-2. The costs of removal of this alga from single meter square areas average over 2.5 hrs per person. Regrowth after experimental removal is complete within about six months. Control of this algal complex will require a multi-agency and multi-organism approach, as we work to develop methods to culture and re-introduce appropriate native herbivores and native plants with outplanting experiments. Without management action, this complex of species is likely to disperse around Oahu and possibly to other islands, and cause considerable loss to coral ecosystems.

Impacts of Invasive Algae Using Gracilaria salicornia as a Case Study

In the 1970's, one of Dr. Doty's students brought small plants of another red alga, Gracilaria salicornia from an area near Hilo Harbor (Hawai'i Island) to Waikiki and Kaneohe Bay to stimulate an aquaculture industry in agar-producing seaweeds. This effort lead to direct plantings adjacent to Hawaii Institute of Marine Biology in Kaneohe Bay and the Natatorium region of Waikiki. The record is clear that this species was not a natural component of the Oahu flora prior to this introduction. Water motion in these regions was sufficient for parts of the plants to break and be carried off the reef, eventually allowing for the escape of this alga to other regions of Kaneohe Bay and Mamala Bay. In the period since that inoculation, this species has now spread to nearly the entire island of Oahu. From studies again by Dr. Jennifer Smith and Eric Conklin, we now know that this alga overgrows corals relatively less rapidly than Kappaphycus but still directly leads to coral death. Ecological studies show clear robust trends of loss of species diversity as Gracilaria salicornia mats increase. The reef at Waikiki typically had an algal flora of 80 macrophytic algae as well as large coral colonies; following this introduction, species numbers dropped to ~ 20. The costs of removal of this alga from single meter square areas average over 8 hrs per person for a single meter square area. Control of this algal will require a multi-agency and multi-organism approach, as we work to develop methods to culture and introduce native herbivores and native plants for outplanting experiments in this case as well as for the control of Kappaphycus. Without management action, this species is likely to disperse to other islands, and cause considerable loss to coral and coastal ecosystems.

Impacts of Invasive Algae Using Hypnea musciformis as a Case Study

In the 1970's, apparently without proper permits, a businessman brought the red alga Hypnea musciformis to provide new materials for aquaculture interests in carrageenan. This plant was cultivated in reef regions in Kaneohe Bay but reportedly never gained sufficient commercial interest for business development. Water motion was again sufficient for parts of the plants to break and be carried off, eventually allowing for the escape of this alga to other regions. In the period since that inoculation, this species has now spread to all Main Hawaiian islands except Hawaii and poses particular problems for Maui. In the last two decades, the impacts of this alga - in terms of biomass accumulation has been reported as high as 20 tons per week of algae washing up on some Maui beaches. Tourism business and related losses amount to as much as $20 million each year, from the first economic assessment to be calculated. These losses come in the form of lost revenues from regions where beachgoers leave, decreased property values and costs to clean beaches. Among the three algae discussed today, a common theme is the remarkable capability of small fragments from branches of each of these algae to regrow whole plants. Hypnea musciformis has specialized hooked branches to attach to other anchor species and thus allow it to remain in a region, at a somewhat cryptic level. We have no data at this time for the average biomass per unit area, nor the time needed to remove plants of H. musciformis at typical observed densities.

Seagrasses such as our endemic Halophila hawaiiana are similarly threatened by the crowding out by a non-indigenous green alga, Avrainvillea amadelpha. This alga is the least studied interaction but potentially has a great impact on our endemic seagrass.

Loss of this seagrass and other native species puts the stability of natural species assemblages at risk,

ecologically and triggers real losses from downturns in tourism and tax bases, economically. Aspects of these issues are illustrated in the Summary Report for the Hawaii Coral Reef Initiative, which has been submitted as part of this testimony.

Conclusion

In closing, it is clear that invasive algae represent a significant threat to coral reefs and seagrasses in Hawai'i. The appearance of this as a "Hawaii-problem" may be as attributable to the simple fact that few other marine botanists have studied the marine plants of other insular US areas in the tropical Pacific. This lack of baseline information coupled with continued introductions of commercially important algae to places like the Marshall Islands, puts the issue of invasive marine algae at the top of reef management, threats and concerns in the tropical Pacific. My colleague Dr. Cindy Hunter will add to this discussion with an explanation of efforts for removal of invasive algal biomass here in Waikiki.

Thank you for the opportunity to address the Subcommittee today; your interest and support are greatly appreciated. I will be happy to answer any questions.