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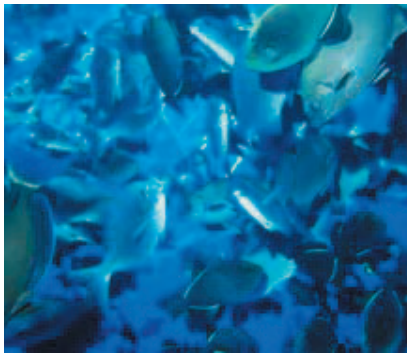
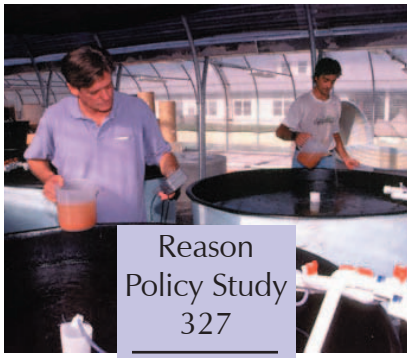
Catching the Aquaculture Wave

By Michael De Alessi
Project Director: Adrian T. Moore, Ph.D








Reason
Policy Study
327

Grassroot
Study 1004

The Grassroot Institute of Hawaii

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The purpose of the Grassroot Institute of Hawaii is to improve the relationship between the government and the people with the objective of improving the effectiveness of the government, the business climate and in some cases, tradition, to foster an atmosphere in Hawaii that results in maximum personal freedom for every individual. We recognize that personal freedom comes with the price of personal responsibility, accountability and respect for others. We believe each person must be free to succeed or fail in building wealth and in relationships with others.

The Mission

The mission of the Grassroot Institute of Hawaii is to identify "people problems," such as barriers to productivity, wealth creation and personal happiness, and then study, analyze, publish and aggressively pursue creative self-government centered solutions. The individual, and his or her search for meaning and happiness in a civil, society is stressed. We are thus Grassroot, not Grassroots.

This study of offshore fisheries in Hawaii was launched because we observed that remarkable foresight by some in a not-so-free market oriented Hawaii legislature to introduce and pass authority for private operators to have some ownership rights in our surrounding ocean. The first major result was the successful Cates International project described in this publication. We told the late Gary Arizala the situation and that we thought a study was in order. He endorsed the idea and funded the project on the Hawaii end. Gary died before this finished product hit the street but was acutely interested to the end. This is our thank you to him, a dedicated advocate of the magic of private property. We miss him, and always will.

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Executive Summary

The island chain of Hawaii is poised on the leading edge of the development of the legal and technical frameworks necessary for open-ocean cage fishfarming. One offshore farm is up and running, and another has all the permits and licenses and is just waiting for the final rounds of financing. As these operations and other potential operators mature and grow, and with the right legal and regulatory reforms, Hawaii has the potential to lead the nation in quality offshore oceanic fish cultivation. This could be a tremendous boon to both Hawaii's economy and its general entrepreneurial climate.

Yet many obstacles remain. Despite studies that show no measurable impact to the environment of the aquaculture already in operation, misplaced fears based on other situations and technologies coupled with a stifling, extended bureaucratic process that allows individuals to contest the permit process with or without reasonable cause hampers Hawaii's chance to develop offshore fishfarming and expand its shrunken economy. This report explores case studies of fishfarming in Hawaii and how the state could reap economic benefits while guarding local waters against environmental impact. With a streamlining of its bureaucracy, Hawaii could soon lead the nation in offshore oceanic fish cultivation, spelling success for its citizens as well as take pressure off of wild stocks of depleted fish populations. It would also powerfully demonstrate how human ingenuity, properly channeled through free enterprise, could sustainably feed people and maintain, or even enhance, a healthy environment.

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Part 1

Introduction

The fish dinner of the future may well come from a farm. While worldwide fish catches are flat, aquaculture is one of the fastest growing new industries.

A. The Fisheries Problem

Most capture fisheries around the world suffer from what is known as "the tragedy of the commons," a phrase coined by Garrett Hardin in 1968 to describe what happens when valuable resources are free for the taking—they are depleted.[1] Or to put it another way, when fish left in the sea are simply there for someone else to catch, there is no incentive to leave fish to maintain their numbers for another day.

The most promising improvement in fisheries management in recent years is the development of fishing rights, often called ITQs (Individual Transferable Quotas) or IFQs (Individual Fishing Quotas), which allocate a certain percentage of the total harvest to specific fishermen. This ends the often destructive (both to people and to the marine environment) race between fishermen, and even more importantly, creates an incentive to invest in the future health of the fishery, because the owners of those rights benefit financially from a healthier fishery. ITQs have been used most successfully in New Zealand, Iceland, and Australia, and a small number exist in the United States as well.[2]

ITQs are relatively rare around the world, however, and as a result, the world fish catch has remained much the same over the last decade or so, hovering around 90 million metric tons, according to the Food and Agriculture Organization of the United Nations.[3] Many of the world's depleted stocks are *not* recovering because the fundamental nature of fisheries management has not changed. That is, it still behooves the average fisherman to catch as much as possible, as quickly as possible.

B. The Growth of Aquaculture

This adds up to no growth in fish catches while aquaculture has grown at an average rate of over 9 percent per annum since 1970.[4] In 2002, the most recent year that statistics are available, worldwide aquaculture production was 51.4 million metric tons (or 39.8 million metric tons if aquatic plants are not included).[5] To put this increase in context, in 1991, world aquaculture production was approximately 13 million metric tons, double what it was seven years before.[6] By 1995 that number had jumped to over 21 million metric tons.[7]

The reason that aquaculture is experiencing such rapid growth is that by “farming” the sea, aquaculturists do not have to worry about the tragedy of the commons. In other words, an aquaculture facility allows entrepreneurs to literally “fence” parts of the sea (or even transport it onto land), ensuring that a fish not harvested today will be there tomorrow, normal rates of mortality notwithstanding.

Aquaculture offers other advantages as well, such as a dependable market supply. Controlling the feed allows fish growers to, for example, increase fat content for sushi chefs or lower it for producers of smoked fish. [8]

C .The Environmental Effects of Aquaculture

Like any rapidly growing industry, aquaculture has its share of detractors, and has caused its share of problems around the world. At issue is the fact that while aquaculture facilities take care of the tragedy of the commons *within* an enclosure, the commons problem remains *outside*.

The problem is exacerbated because most aquaculture (about two-thirds) takes place in bays, estuaries, and other shallow, nearshore marine environments where water circulation is often slow and important habitats such as mangrove forests are often nearby. Intensive aquaculture in these areas can produce significant amounts of organic pollution, which can lead to reduced levels of oxygen in the water and an increase in quick-growing algae harmful to marine life. In some cases there is also growing concern over the antibiotics used and the effect of escaped animals on the gene pool of wild populations, especially in the case of Atlantic salmon raised in Pacific waters.

Unfortunately, critics of aquaculture tend to ignore the perverse incentives created by the tragedy of the commons, instead vilifying aquaculture, particularly salmon farming in developed countries like the United States and Canada, and shrimp farming in developing nations such as Thailand and Ecuador. Activists even held a mock trial in New York a few years ago to try shrimp farmers in Thailand for ‘despoiling their country's coastal wetlands by raising shrimp.’[9]

They do have a point. According to United Nations estimates, only 40,000 acres of mangrove forest remain in Thailand, down from nearly a million acres just thirty years ago.[10] Shrimp farming has certainly contributed to this decline, as hypersaline water and a sludge of nutrients from Thai shrimp ponds have damaged mangroves, and many ponds have been built in mangrove forests themselves.

Still, Alfredo Quarto, a director of the Mangrove Action Project, has pointed out that the main reason why shrimp farmers choose to clear mangrove forests is that they are usually government-owned.[11] Countries such as Thailand, Malaysia, and Ecuador have also subsidized aquaculture and expropriated communally-held lands for aquaculture.

The answer to the problem of the aquaculture equivalent of “slash and burn” agriculture is secure tenure. Of course, the most secure form of tenure is a deed to the land, but few underwater areas are so parceled out. One exception in the United States, however, shows that with secure tenure, aquaculture can be a positive force for environmental protection. After all, the creatures inside an aquaculture facility depend on clean water and a clean environment to grow.

In Washington State, oyster beds are owned in fee simple—completely privately, and with a title to prove it—so that oyster growers seed their beds rather than relying on wild harvests. Because oysters are filter feeders and therefore especially sensitive to water quality, Washington State's oyster growers have been, for almost a century, the staunchest defenders of water quality in that state.[12] In the 1950s, for example, they were especially successful at curbing sulfite pollution from Washington's pulp mills.

Another solution to the potential problems created by nearshore aquaculture is to move operations offshore, where water circulation is better and risks from pollution, both exogenous and endogenous, are limited. After all, an oft-repeated mantra is "the solution to pollution is dilution."

Of course, offshore aquaculture creates a number of challenges, including engineering anchoring, feeding, and harvesting systems, monitoring and transporting to far-off sites, navigation, mammal interactions, and finally, ocean leasing. But offshore aquaculture is overcoming those challenges and moving beyond the experimental stages in a number of places around the world.

D. Catching the Aquaculture Wave

Every coastal state in the United States may see its economy benefit from the growth of the aquaculture industry, but Hawaii, surrounded by ocean and on the nexus of the Asian and North American markets, has the most to gain. Hawaii may be uniquely poised to take advantage of this new technology, due to historical precedent, its natural setting, some prescient research efforts, and finally, some real entrepreneurial activity. It is a case study for overcoming the challenges to aquaculture and reaping the benefits. Examining the development of offshore aquaculture in Hawaii, how the current operations and permit seekers are doing, and exploring reforms and further potential provides key lessons for policy makers in Hawaii and other coastal states.

Part 2

Aquaculture in Hawaii

In Hawaii, in 2002 (the latest year that figures are available), the value of aquaculturally grown fish, shellfish, and algae totaled $25.2 million, a 13 percent increase from the previous year. Finfish accounted for about 11 percent of the total. [13]

Hawaii is a state blessed with tremendous beauty and natural resources. While Hawaii is justly known for its diversity of flora, fauna, and even human populations, its economy over the last forty years can be pretty much summed up by sugar and pineapples, defense, construction, and tourism.

Apart from tourism, there is little innovative, competitive, entrepreneurial activity in Hawaii's economy, and the growth of the state's Gross State Product (GSP) bears that out. The annual percentage increase in GSP began a steady decline in the 1960s, from an average high then of almost 6 percent per year, to nearly zero and even negative growth in the 1990s.[14] From 2001 to 2003, real growth of GSP was back up around 1.2 percent per annum.[15]

Despite the fact that Hawaii receives more federal tax dollars than it sends to Washington, D.C., Hawaii's state and local tax burden ranks as one of the most onerous in the nation. According to The Tax Foundation, "For the past 14 years, Hawaii has consistently had one of the nation's highest tax burdens."[16] It is abundantly clear that Hawaii has not fostered an entrepreneurial climate.[17] There is some cause for optimism, however, as Hawaii's geography places it at the nexus between Asian and North American markets.

The potential growth of an offshore aquaculture industry in Hawaii is a specific cause for cautious optimism. Aquaculture is one of the world's fastest growing methods of food production, but is often accused of fouling the local environment. But technological advances and Hawaii's vast ocean, clean water, rapid currents, and steep dropoffs seem ideally suited to addressing these concerns. Most importantly, the state of Hawaii has taken some legislative steps to allow for ocean leasing, which has paved the way for one successful offshore aquaculture operation and a completed permit for another.

A. Historical Precedents for Marine Tenure and Aquaculture in Hawaii

Throughout the South Pacific, traditional societies made use of marine tenure to ensure the conservation of marine resources. Control over these reefs and lagoons, and the fishing within them, typically resided with a clan, chief or family, and extended from the beach to the outer edges of the reefs, or even as far as the visible horizon.

Many of these tenure arrangements were abrogated by European settlers, and most marine management regimes are still based on Western conservation practices. However, Bob Johannes, a renowned biologist, believes that there is not an island in Oceania where marine resources are conserved more effectively today than they were before Europeans came onto the scene.[18]

The form of communal ownership familiar to Hawaiians is known as Ahupua'a, which refers to an essentially triangular strip of property running from mountaintop out to sea. In other words, the Hawaiians understood the interconnectedness of their environment, from the top of the volcano to the watersheds below, to the reefs that spread out to sea. According to a Hawaii Sea Grant study of indigenous ocean rights in Hawaii, this system was set up "to sustain the pattern of Hawaiian life," and included strict limits on harvests of "species, types, sizes, and portions of fish."[19]

Further evidence of a Hawaiian awareness of the tragedy of the commons is the presence of fish ponds used by the Hawaiians to both store and grow captured fish. These ponds, almost unique in the Pacific, were generally formed using coral or lava rocks to create a pond at the edge of a body of fresh, brackish, or ocean water. Water circulated through them naturally, and there is even some likelihood that fish reproduced in them. In other words, the fish ponds were grow-out and holding facilities, which is essentially an aquaculture facility.

In 1778, when the first Europeans arrived in Hawaii, it has been estimated that there were 360 fishponds producing 900,000 kg of fish per year, but their use soon declined and by the 1980s, few remained in use.[20] Since then, some fishponds have been restored, and conventional nearshore and onshore aquaculture in Hawaii has grown into a real business. Still, in 2002, aquaculture accounted for less than .06 percent of Hawaii's GSP. Land prices in Hawaii are exceptionally high, and so extensive onshore aquaculture is unlikely. If there is going to be major aquaculture growth in Hawaii, it will have to be offshore.

B. The Hawaii Open-Ocean Aquaculture Demonstration Program (HOARP)

The prospects and potential of offshore aquaculture in Hawaii appealed to a number of government grantmakers and university researchers, especially the Oceanic Institute (an aquaculture research facility on Oahu), the State Aquaculture Development Office, and the University of Hawaii Sea Grant College.[21]

Their combined efforts led to an international conference in April 1997 on Open-Ocean Aquaculture, which brought experts from around the world to Maui to share their expertise and experience.[22] The conference served as something of a launching pad for an effort to fund the Hawaii Open-Ocean Aquaculture Demonstration Program (HOARP), a joint effort of the University of Hawaii and the Oceanic Institute to actually put a cage in the water to test both the technical and environmental performance of an offshore aquaculture facility.

The project, which began in 1998 and is now in its third phase, appears to be a great success. The first two phases demonstrated that offshore aquaculture was possible in Hawaiian waters, that the technical difficulties were surmountable, and that the environmental effects were negligible—by some measures even undetectable. The third and later phases constitute continued monitoring of the environmental effects of the commercial cages now in the water.

A Sublime Serving of Moi: Moi 'En Papillote'

Moi served with Hau'ula tomato concasse, shiitake mushrooms & chili pepper water-konbu broth

8 moi fillets (2 oz each)
1 ounce unsalted butter, cut in 8 pieces
4 tablespoons sliced shiitake mushroom
4 tablespoons julienned green onion

Marinade:
¾ cup water
¼ cup mirin
¼ cup light soy
1/8 cup sugar

Tomato concasse:
6 tablespoons finely diced Maui onion
1 tablespoon minced garlic
3 tablespoons olive oil
1 cup diced tomato meat (skins only, no seeds)
1/2 teaspoon salt
2 teaspoons fish sauce
1/4 teaspoon sriracha

Konbu Broth:
2 tablespoons konbu extract
14 tablespoons water
2 tablespoons chili pepper water
¼ teaspoon salt

Combine marinade ingredients. Marinate moi for 14 hours.

To make tomato concasse: Saute onions and garlic in olive oil until well cooked. Stir in tomato meat, salt, fish sauce and sriracha. Cook until warmed through. Cool.

To make broth: Combine ingredients and set aside.

Remove moi from marinade and place each fillet on the bottom of a piece of foil. Top each fillet with 2 teaspoons tomato concasse. Pour 2 teaspoons broth over fish. Top with 1 piece of butter, shiitake mushrooms and green onion. Close pouch foil pouch. Place in steamer for 8 minutes or grill packets for 8 minutes.

Courtesy of L'Uraku restaurant, Honolulu, Hawaii

The fish that was chosen for HOARP was the Pacific threadfin (*Polydactylus sexfilis*), known in Hawaii simply as "moi." Moi is a reef fish that was once the favorite fish of Hawaiian royalty, but had since been fished out to the point that there was essentially no commercial fishery. Still, the fish retained a cachet in the local Hawaiian market, and it was thought that the fish offered a good chance of marketability if the offshore experiment proved viable.

The cage used was a Sea Station 3000, made by a company called Ocean Spar. It resembles two cones joined at their widest and is approximately 50 feet (15 meters) tall and 80 feet (25 meters) wide. There is a 15 meter long central spar that goes through the middle of the cage, which is surrounded by a steel rim 25 meters in diameter. Taut netting forms the cage, creating an internal volume of about 92,000 cubic feet.[23] In the HOARP case and its continued commercial application, it lies about 40 feet under the surface and about 50 feet off the seafloor.

The site that was chosen for the experiment was about 2 miles offshore of Oahu, not too far from the port facilities of Honolulu, an important consideration for both research and eventual commercial access and distribution. The cage was purchased in late 1998 from Ocean Spar, a private company in Washington State.[24] The cage was deployed in the spring of 1999 and stocked with between 50,000 and 70,000 fingerlings raised at the Oceanic Institute.[25] All of the fish in the cage were harvested in September and October of 1999. Throughout the time that the fish were in the cage, water quality was monitored inside the cage, nearby the cage, and as far as a reef three-quarters of a mile away.

Researchers found no pollution signature at any of the monitoring sites, and at first assumed some error in data collection. That changed, however, when the same experiment was repeated in 2002, using the same site but doubling both the number of fish in the cage and the number and intensity of monitoring measurements. This experiment confirmed that there was no measurable effect of the cage beyond 100 feet.[26] Inside that 100 feet, there was a barely perceptible increase in ammonium (i.e. fish urination) and an increase in the sea life underneath the cage, probably more as a result of the structure than escaping feed or fish.

According to Charles Helsley of UH Sea Grant, HOARP showed that "indeed, it was feasible to grow a local fish in offshore cages, that the technology was mature enough to withstand the rigors of our rough offshore waters, and that the environmental impact was virtually nil."[27] Along with the refinement of feeding techniques that allow very little food to escape from the cage, the most important factor is Hawaii's fast currents and clean water. Hawaii's currents average .2 knots; at .1 knots more than 217 million gallons of water will flow through the HOARP cage each day.[28]

At this stage the academic experiment was largely concluded, but the marine contractor who had installed and maintained the cage, and fed and harvested the fish, decided to try to farm offshore commercially. Safety Boats Inc. was a full partner with UH and the Oceanic Institute in the project, so was well-equipped to take over the operation. First, however, was a new round of permitting to obtain both a lease area for the farm, and a number of operating permits. Once the lease and the permits were obtained (see below), benthic and water quality monitoring by UH continued at the new site, and still does.

C. Leases and Operating Permits for Offshore Aquaculture in Hawaii

While the Oceanic Institute and the University of Hawaii worked on demonstrating that offshore aquaculture was feasible and environmentally sound, the Hawaii Department of Aquaculture Development worked on getting a workable offshore aquaculture law passed that would allow for commercial development.[29] The governor signed off on the Ocean Leasing Act in 1999, which made offshore aquaculture possible, but only with the right permits.

Even for HOARP, an academic endeavor with an NOAA-funded UH sponsor, obtaining the necessary permits was tricky. Still, Charles Helsley of UH Sea Grant, and John Corbin and Leonard Young in the Hawaii State Aquaculture Development Office, in particular, worked tirelessly for the better part of a year to get through the permitting process, which included two permits from the Dept. of Land and Natural Resources (DLNR) and one permit from the Army Corps of Engineers, along with being vetted by the State Department of Health, Department of Economic Development and Tourism, and the Office of State Planning, as well as the U.S. Coast Guard, and the U.S. Navy.

And this was the easy route. First, HOARP would be in Hawaiian waters (within five km of shore), which made the process simpler than it would have been in federal waters with many additional jurisdictions to contend with. Second, the lease for the cage site was set up under a research permit, which is far less strict than a commercial permit.

In fact, commercial offshore aquaculture was not possible until an ocean leasing law was passed in 1999 by both state houses and the governor. The law gave jurisdiction over ocean leases to the Board of the Department of Land and Natural Resources, with the explicit assistance of the Aquaculture Development Office in the State Agriculture Department. A previous law had been passed some years before, but proved unworkable in practice. In fact, it only permitted the use of offshore water for the growing of shellfish.

The revised law paved the way for the first commercial lease and permit applications filed by Cates International (the former Safety Boats Inc). Cates began setting up its commercial offshore operation in March 2001 under a temporary permit issued by the state, but it wasn't until August 2002, 18 months later, that the lease was officially granted.

The permitting process, which went on at the same time, took about 16 months, followed by another six months to get an NPDES permit (National Pollutant Discharge Elimination System), which had to follow the completion of the state and Army Corps permitting process.

The most important permit is a conservation district use permit (CDUP). In Hawaii, submerged lands have been legally classified as conservation districts, which means that they are essentially set aside for conservation. Thus, the offshore aquaculture applicant must convince the DLNR to allow for a commercial use of a conservation area. The procedure for doing so involves collaboration between numerous state departments and a lengthy and comprehensive public hearing process. The public has the ability to contest the application, which triggers a whole new set of requirements and hearings.

1) Permits required for the operation of offshore aquaculture in Hawaii

- A Hawaii state CDUP (conservation district use permit), which requires a comprehensive EA (environmental assessment) or EIS (environmental impact statement), extensive consultation with the community, public hearings, and separate Hawaii State Land Board approvals of both the project and the terms of the lease. [30]

- A Hawaii State Department of Health Clean Water Branch permit, which is granted under the NPDES (National Pollutant Discharge Elimination System) under the Clean Water Act. Oversight lies with the U.S. EPA.

- A U.S. Army Corps of Engineers section 10 permit for compliance with all federal regulations, including any possible effects on endangered species monitored by U.S. Fish and Wildlife, on marine mammals by the National Marine Fisheries Service, and on navigation by the U.S. Coast Guard.

- A Hawaii State aquaculture license, which requires a demonstration of expertise, sufficient facilities, and chain of custody over the fish from farm to consumer.

- A Hawaii State Department of Health Solid Waste Disposal permit.

2) Ceded Lands in Hawaii

One final regulatory and policy issue for offshore aquaculture in Hawaii is the issue of ceded lands. Ceded lands are so called because they were originally ceded by the Republic of Hawaii in 1898 to the United States, which them turned them back over to the State of Hawaii when it was granted statehood in 1959. Twenty percent of the proceeds from the lease of these lands goes to the Office of Hawaiian Affairs (OHA), which is tasked with using the money to benefit native Hawaiians.

This is important for aquaculture because the submerged lands of the state are considered to be part of the ceded lands, so a share of the lease revenues go to OHA. To date, OHA has done little to either hold up or promote offshore aquaculture, apart from grumbling that the lease fees are too low.

Offshore aquaculture, however, may offer a fantastic development opportunity for native Hawaiians if OHA sees its interest in ceded lands as an opportunity for investment rather than simply another source of revenue. In New Zealand, for example, the native Maori population owns a share of the commercial fisheries there. When they were awarded this right after a court case in 1992, however, instead of selling or leasing their fishing rights, they bought into a 50 percent stake in a company called Sealord, which is now jointly owned by the Maori Treaty Commission and a Japanese seafood company.[31]

Sealord is a very successful company. If OHA thought more like the entrepreneurs in New Zealand and in Hawaii's offshore aquaculture business, it could capture significant funds to help native Hawaiians. But even beyond helping native Hawaiians, offshore aquaculture in Hawaii holds great promise for expanding Hawaii's fisheries industry and rehabilitating foundering fish populations. And all with little or no detriment to the environment.

Part 3

Aquaculture Case Studies in Hawaii

Cates International, Inc.

As an entrepreneurial endeavor, Cates International is impressive. Randy Cates and his partner Virginia Enos founded the company out of a marine salvage operation and staffed it with a crew of former commercial divers and fishermen. Cates's familiarity with the working conditions of the sea was a crucial element in taking on commercial fishfarming. For example, the boats used to both harvest and feed the fish in the cages were built in-house by Cates.

The cages, which sit approximately 40 feet under the surface, were originally intended to be raised to the surface for harvesting and feeding. When it appeared that it would be difficult to get a permit to raise the cages, however, Cates decided to simply engineer a way to feed and harvest the fish without ever raising the cage to the surface.

In March 2001, Cates International leased the experimental cage from HOARP, and only had to move it about 1,000 feet to its new lease site. Cates had its first commercial harvest in January of 2002, but it took until August 2002 for Cates to be able to sign a commercial lease for the spot. The reasons the lease took so long include the fact that some permits must be sequential (that is, one permit must be obtained before another can be applied for) and the fact that even a single citizen could contest the process and thereby hold it up.

According to Randy Cates, one such opponent from the general public "cost us dearly, in delays and money—about $50,000 in legal bills."[32] With Cates well-prepared for his day in court, his opponent failed to show up, and so the complaint was dropped.

The lease has a term of 20 years, and Cates is charged an annual rate of $1,400 or 1 percent of the gross revenues, whichever is higher, which is not much different from the terms set by the state on land. The site covers 28 acres underwater, and allows for up to four cages. Cates currently has four cages, which cost about $100,000 each to purchase from Ocean Spar Technologies.

Cates International is now providing moi to restaurants and consumers throughout the islands, harvesting 5,000 to 6,000 pounds of fish per week from the cages submerged at the lease site. As a privately held company, Cates does not release its profit numbers, but in spring 2004, moi was selling in retail markets

around Hawaii for $5 to $6 a pound. One fish company buys all of Cates's production, and seems to have no problem moving the fish.

The biggest problem that Cates has now is supplying fingerlings to stock the cages. Currently, the moi fingerlings are provided by the Oceanic Institute, a research facility that is not set up for large-scale commercial production, nor is it especially interested in large-scale production. The production by Oceanic has recently increased from about 100,000 fingerlings every two months, which translated to an annual production for Cates of about 300,000 pounds of moi, to 150,000 to 200,000 fingerlings ten times a year. By December 2005, Cates plans to be producing 15,000 pounds of moi a week, which will translate into an annual production of over 750,000 pounds of fish.[33]

Cates does get a good deal on the fingerlings, which are sold at cost (of production, not development) by the Institute. Cates would like to start up its own hatchery, but planning is bogged down in the regulatory process necessary to do so, as well as the cost and availability of coastal land to use for agricultural purposes.

The fingerlings that Cates does acquire from the Oceanic Institute are flushed into the submerged cages through a tube that leads into a nursery net, a smaller net inside the larger cage that keeps in the small fish. They grow quickly, however, reaching a marketable size of one pound in about six to eight months.

Kona Blue Water Farms

A second offshore aquaculture operation is gearing up off of the Kona coast on the Big Island of Hawaii. Known as Kona Blue Water Farms, partners Dale Sarver and Neil Sims obtained the last of their regulatory permits in March 2004. The last hurdle remaining for them is fundraising, of which they are looking for about $3 million. Securing their permits took Kona Blue Water Farms three years, without any unforeseen hold-ups, and without being contested by any member of the public.

Kona Blue Water Farms had the benefit of building off of the success and environmental record of Cates International, but their business will be different in some significant ways. Perhaps most importantly, Sarver and Sims already have a hatchery in operation, which has grown out of another business of theirs, Black Pearls, Inc. In fact, they are already selling small quantities of shore-raised fish to local restaurants. On the downside, they do not have the blue water experience of a marine salvage company behind them, and the fish that they will grow out—known as "kahala" or amberjack—is not a popular food fish (yet) due to its tendency to accumulate ciguatera toxin.

Bred in captivity, however, there is no danger of toxicity in kahala, and Sarver and Sims are convinced that the fish will find a niche market for high-grade sashimi, especially since their farm-raised version will have a higher fat content than the wild version.

Kona Blue Water Farms obtained a 20-year lease on a 90-acre area just off of the Kona International Airport. They plan to have six cages in 200 feet of water and two smaller nursery cages on the surface.[34] When fully operational, Kona Blue Water Farms hopes to grow 360 tons of kahala a year, and to sell it for as much as $6.00 a pound, in large part due to the demand in Japan for what they call kampachi.[35]

Ahi Farms Inc.

Ahi Farms was founded by Harry Ako, a University of Hawaii professor who is especially well-known for his work on formulating feed for aquaculture. Ahi Farms, Inc. has applied for permits to put cages offshore of Waianae in northwestern Oahu. The cages will be filled with juvenile (5 to 6 pounds) yellowfin and bigeye tuna caught by local fishermen, which will then be fed and grown out to sizes of up to 100 pounds.

Because few juvenile tuna ever reach spawning age, Ahi Farms believes their cages will have no net effect on wild tuna populations, and relying on local fishermen will provide much-needed employment in an economically depressed area of the island. The founders have met with many native Hawaiians to get their blessing, and have also reached out to as many environmentalists as they could find. After securing support from fishermen, Hawaiians, and environmentalists, however, Harry Ako is growing increasingly frustrated with the permitting process. At a meeting of the World Aquaculture Society in Honolulu in March 2004, Ako described Ahi Farms efforts: "Presently we are attempting to address concerns of a fourth group we did not plan on being a problem, state bureaucrats."[36] According to Ako, his frustration stems from missed response deadlines and the difficulty of trying to figure out just what standards need to be met for a permit to be approved.[37]

Ahi Nui

Ahi Nui is another proposed offshore operation for growing out juvenile yellowfin and bigeye tuna, in this case off of the coast of the Big Island. Ahi Nui began applying for permits in 2002, but has since withdrawn its application because of opposition within the local community.

One of the biggest problems for both of these operations is that tuna need to be in surface cages (they will bump up against a cage top and injure themselves). This certainly increases the visual impact and concern of locals over the farms. In addition, they are currently planning to rely on wild harvests of fish, which, whatever the real impact on wild populations, probably generates concern. Some environmentalists, for example, differentiate between submerged and open-cage aquaculture, believing that "Although closed-cage fish farms like those of Cates International hold great economic potential for Hawaii, other types of ocean aquaculture can present a danger to our pristine waters."[38]

Pacific Ocean Ventures

The most recent company to prepare an offshore lease application is Pacific Ocean Ventures (POV), which is hoping to follow the Cates business model off the coast of Maui. POV would like grow moi and kahala in cages similar to Cates's, as well as to build its own hatchery on shore. POV has just begun the CDUP process.

Part 4

Overcoming Environmental Challenges

After the first year of commercial operation, UH researchers monitoring water quality continued to give Cates International a clean bill of health. With nearly 300,000 fish in two cages and up to 3,000 pounds of feed delivered daily, downstream water samples taken out to 3,000 feet away show no unusual changes in plankton or bacteria abundance.[39] There have been some increases in ammonium (above 3.5 parts per billion), but no increases in nutrients such as phosphorus and nitrates.

Benthic studies of the seafloor surrounding the cages show increases in some organisms directly beneath the cages, but no evidence of any anaerobic sediments or even food accumulation beneath the cages.[40] In other words, the structures moored to the seafloor are acting similarly to artificial reefs, which are well-known to both attract and produce marine life.

In addition, Cates's operation seems to have found favor with locals, no doubt in part due to the lack of exclusivity over the cages, which allows people to dive and fish around the cages, so long as they don't enter them or interfere with their operation. According to Randy Cates, they "haven't had one complaint about it."

Despite the success of the HOARP study and the continued monitoring of Cates International, offshore aquaculture still stirs fears in Hawaii. Many of these fears are based on the past sins of nearshore aquaculture, but some are directly addressed at offshore aquaculture (see Table).

For example, an advocacy group called the Institute for Agriculture and Trade Policy (IATP) issued a report in February 2004 in response to a possible federal open-ocean aquaculture policy. The report claimed that offshore aquaculture could be "a brand new giant biopolluting industry, [and] a wholesale privatization of the Continental Shelf and an end to public stewardship over the oceans."[41] When confronted with the success of the HOARP experiment, the IATP responded that it was concerned over the private use of a public resource—a far different matter from concern over the environmental sustainability of offshore aquaculture in Hawaii. And as noted earlier, the biggest problem facing the oceans is the tragedy of the commons, which may be exacerbated by private efforts (as with many wild fisheries where no harvest rights exist), but creating secure tenure in the seabed is a step toward sustainability, not the reverse.

The most recent offshore aquaculture permittee has even managed to garner the support of the local chapter of the Sierra Club, by convincing them of the minimal environmental impact of offshore aquaculture, and by agreeing to a completely transparent and public water quality measurement regime.

Table 1: Concerns About Aquaculture and the Offshore Solution to Them	
Concerns	**How Cates International Offshore Aquaculture in Hawaii Addressed These Concerns**
Escapees could affect local gene pool, or could establish wild populations	Only local species are used, and hatcheries are the same as are used for stock enhancement in the wild
Organic pollution could foul marine environment	Three-phase study by the University of Hawaii showed virtually no impact on the marine environment, save for some ammonium (fish urine) and increased attraction of species around the cages due to the artificial reef effect.
Leasing the seabed will reduce access to the marine environment for Hawaiians	Fishing and diving allowed over and around cages
Unsightly from shore	Completely submerged
Could effect navigation	Cages are 40 feet under the surface
Fish diseases could spread rapidly in an enclosed environment	No outbreaks of disease in both HOARP and commercial stocking densities

Part 5

Conclusion and Recommendations

There is no question that Hawaii is uniquely poised to lead the nation in offshore oceanic fish cultivation. In fact, with Cates International, Hawaii is *already* a world leader. But Cates is a small operation, and many other entrepreneurs are hoping to jump into the fray. Of course Hawaii's natural assets are too precious to throw caution to the wind, but the precautionary approach that has so far been taken by every regulatory agency involved is throwing up too many roadblocks to aquaculture development.

If those roadblocks remain, offshore aquaculture in Hawaii may languish instead. Streamlining procedures, on the other hand, will encourage innovation, investment, and creativity—the necessary human ingredients for entrepreneurial leadership. If the regulatory process can be streamlined so that environmentally sustainable aquaculture can proceed in a timely fashion, then Hawaii will find itself on the leading edge of one of the world's fastest growing industries.

Four elements are key to developing an environmentally and economically sound offshore aquaculture industry:

- Strict water quality monitoring requirements for all commercial aquaculture operations should be maintained.
- Regulations, permits, or procedures that create more paperwork than environmental benefits should be scrapped or simplified.
- Permits should be handled concurrently rather than consecutively. That is, applicants should be able to file simultaneous applications, rather than waiting for one permit to be granted before another can be applied for (as is the case with NPDES permits, which must follow the completion of the state and Army Corps of Engineers permitting process).
- The ability of the public to contest a conservation district use permit (CDUP) should be simplified so that public input is still taken into account, but not to the extent that anyone may hold up the permitting process without clear cause.

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Related Reason Foundation Studies

Michael De Alessi, *Preliminary Ocean Policy Report Misses the Boat*, Reason Foundation Policy Brief No.29, April 2004, http://www.rppi.org/pb29.pdf

Michael De Alessi, *Overcoming Three Hurdles to IFQs in U.S. Fisheries: A Guide for Federal Policy Makers*, Reason Foundation Policy Brief No. 28, April 2004, http://www.rppi.org/pb28.pdf

Michael De Alessi, *Saving Endangered Species Privately: A Case Study of Earth Sanctuaries, Ltd.*, Reason Foundation Policy Study No, 313, August 2003, http://www.rppi.org/ps313.pdf

Endnotes

[1] Garret Hardin, "The Tragedy of the Commons" *Science*, Vol. 162**,** p. 1,243-48, (1968). Hardin drew on the earlier work of economists such as H. Scott Gordon ,"The Economic Theory of a Common-Property Resource: The Fishery" *Journal of Political Economy*, Vol. 62**,** p. 124-42 (1954), and Anthony Scott, "The Fishery: The Objectives of Sole Ownership" *Journal of Political Economy*, Vol. 63**,** p. 63-124 (1955).

[2] See, for example, Michael De Alessi, "Sustainable Development and Marine Fisheries" in Julian Morris (Ed.), *Sustainable Development: A Prime*, (London: Institute of Economic Affairs, 2002, pp. 206-221), Available on the Web at http://www.sdnetwork.net/pdfs/michael_dealessi_chapter13.pdf . The Web site www.ifqsforfisheries.org also has current updates on IFQs in the United States.

[3] Food and Agriculture Administration of the United Nations (FAO), *The State of World Fisheries and Aquaculture*, (Rome: FAO, 2002), http://www.fao.org/sof/sofia/index_en.htm.

[4] FAO, 2002.

[5] FAO, "Yearbook of Fishery Statistics" 2002. Available on the Web at ftp://ftp.fao.org/fi/stat/summary/default.htm

[6] FAO, *Aquaculture Production 1985-1991*, (Rome: Food and Agriculture Organization of the United Nations, 1993).

[7] FAO, *The State of World Fisheries and Aquaculture*, (Rome: Food and Agriculture Organization of the United Nations, 1997).

[8] Mark Bittman, "Today's Fish: Straight from the Farm," *New York Times*, September 18, 1996.

[9] S. Mydans, "Thai Shrimp Farmers Facing Ecologists' Fury," *New York Times*, April 28, 1996.

[10] Mydans, "Thai Shrimp Farmers Facing Ecologists' Fury."

[11] Michael Weber, "The Fish Harvesters: Farm Raising Salmon and Shrimp Makes Millionaires, and also Creates Dead Seas," *E Magazine*, November/December, 1996.

[12] Michael De Alessi, "Oysters and Willapa Bay," (Washington, D.C.: Center for Private Conservation Case Study, March 1996).

[13] Hawaii Agricultural Statistics Service, "Hawaii Aquaculture" September 2003. Available on the Web at http://www.nass.usda.gov/hi/rlsetoc.htm

[14] Hawaii Department of Business, Economic Development, and Tourism. 3rd Quarter 1995, *Business and Economic Statistics*, http://www2.hawaii.gov/DBEDT/index.cfm?parent=statistics_and_economic_information.

[15] Hawaii Department of Business, Economic Development, and Tourism. "Actual and Forecast Key Economic Indicators for Hawaii: 2001 to 2006" December 2003. Available on the Web at http://www.hawaii.gov/dbedt/news/2003/0354.html

[16] The Tax Foundation, "The Facts on Hawaii's Tax Climate" http://www.taxfoundation.org/hawaii/ downloaded July 2004.

[17] See, for example, the op-ed by Shirley J. Daniel, the Henry A. Walker Distinguished Professor of Business Enterprise and director of the Pacific Asian Management Institute at the University of Hawaii College of Business Administration, entitled "Is Hawaii an entrepreneurial place?" in the *Honolulu Star Bulletin*, April 12, 2002. available on the Web at http://starbulletin.com/2002/04/12/business/pacific.html

[18] Robert Johannes, "Traditional Marine Conservation Methods in Oceania and Their Demise," *Annual Review of Ecological Systems*, 1978, pp. 349-64.

[19] Norman Meller, "Indigenous Ocean Rights in Hawaii," Sea Grant Marine Policy and Law Report UNIHI-SEAGRANT-MP-86-01 (Honolulu: UH Sea Grant College Program, December 1985).

[20] The Oceanic Institute, "Hawaiian Aquaculture" downloaded July 2004 from http://www.oceanicinstitute.org/aboutus/aquahawaiian.html

[21] See Hawaii Aquaculture Development program http://www.hawaiiaquaculture.org/ ; The Oceanic Institute http://www.oceanicinstitute.org/ ; Hawaii Sea Grant program http://www.soest.hawaii.edu/SEAGRANT/index.php

[22] See *Open Ocean Aquaculture '97: Charting the Future of Ocean Farming*. Proceedings of an International Conference. Charles Helsley (ed), UH Sea Grant College Program #CP-98-08. April 23-25, 1997, http://nsgl.gso.uri.edu/hawau/hawauw97002/hawauw97002index.html.

[23] "Aquaculture in Hawaii", *Fishfarming News*, Nov/Dec 2003.

[24] See www.oceanspar.com for technical details.

[25] Charles Helsley, "Open Ocean Aquaculture in Hawaii," *Hawaii Fishing News*, March 2003.

[26] Ibid.

[27] Quoted in Environmental News Service, http://www.ens-newswire.com/, February 11, 2004.

[28] Helsley, "Open Ocean Aquaculture in Hawaii."

[29] For an overview of the legal and regulatory environment for offshore aquaculture in Hawaii, see Casey Jarman, Scott Mowrey, and Della Au Belatti, "Developing Aquaculture in Hawaii," Environmental Law Program, University of Hawaii at Manoa, William S. Richardson School of Law. White paper, nd.

[30] Kona Blue Water Farms, "Update on KBWF's proposal for an open ocean fish farm off unualoha point, Kona" press release issued January 31, 2003, http://www.blackpearlsinc.com/3_4.shtml.

[31] See the New Zealand Fishing Industry Council website http://www.seafood.co.nz/business/mgmtsus/mfish.asp for more information on Maori fisheries.

[32] "Subsea Moi for Market," *Fishfarming International*, April 2002.

[33] Randy Cates, personal communication, September 2004.

[34] Terrence Sing, "Company proposes Kona coast's first ocean fish farm" *Pacific Business News*, March 26, 2004.

[35] "Novel species producer eyes Hawaii's open ocean," *Intrafish*, November 7, 2003. http://www.intrafish.com/"

[36] Harry Ako, "Anticipated Social/Economic Challenges to Open Ocean Aquaculture Permits in Hawaii," Abstracts of Aquaculture 2004 – Annual International Meeting of the World Aquaculture Society, March 1-5, Honolulu, Hawaii. p. 12.

[37] Harry Ako, personal communication, November 2003.

[38] Mark Grandoni, "Open Pen Aquaculture—A Threat to the West Hawaii Tourism Industry," *Kako'o*, no date, http://www.kamakani.org/ahinui.html

[39] Helsley, "Open Ocean Aquaculture in Hawaii."

[40] Ibid.

[41] Environmental News Service, "Open Ocean Aquaculture Controversial," www.ens-newswire.com February 11, 2004.