UNITED SOYBEAN BOARD-AQUACULTURE INDUSTRY COALITION MEETING
SUMMARY REPORT

The USB-Aquaculture Industry Coalition held its seventh annual meeting on March 3, 2011, during the Aquaculture America 2011 conference. It took place at the New Orleans Marriott Hotel New Orleans, LA. The industry was represented by an estimated 150 soybean processors, aquafeed millers, ingredients and equipment manufacturers, fish farmers, aquaculture association officers, university, federal and private researchers, private consultants and state aquaculture extension, coordinators and Sea Grant officials and state and federal employees. Soybean farmers were represented by grower-leaders and state and national staffs. The program was opened by Gil Griffis, the Soy in Aquaculture New Uses Consultant for the United Soybean Board. He said the Coalition is primarily an educational forum for the sharing of ideas and defining problems on which we can work together to solve. Our mutual goal is to build stronger our domestic soybean and fish growing industries and the many firms and programs that support them. The idea for a Coalition came from soybean farmers, who want to bring closer the day when soybean meal and soy protein concentrates can become an even more important nutritional, economical, renewable and environment-friendly source of protein in all fish rations. Initial support for the Coalition came from fish farmers, who want to grow and market more of their production in the United States, from the many industries that support them, and from state and federal researchers who want to solve problems that limit fish production and soy inclusion rates. Participation in our Coalition meeting has grown from 30 at the initial meeting in 2005 to over 150 attending the event in New Orleans. He then reviewed the agenda and introduced the first speaker.

Mr. Rod Smith is the staff editor and writer with the international weekly newspaper, *Feedstuffs*. Mr. Smith opened his presentation, entitled "The Rise and Rise of the U.S. Chicken Industry", by emphasizing the critical role the consumer plays in any business. He noted that while a supplier delivers products and services to the consumer, the successful supplier delivers solutions to the consumers' issues. He then described some of the attributes of a typical consumer in regard to the purchase of food. He reported half of every dollar spent on food is for a meal purchased outside the home, 51% of which is carried out. Of all office workers, 67% consume a minimum of one meal per day in the confines of their building, with breakfast and dinner becoming increasingly the first and second in growth. Meals prepared outside the home are considered "absolutely essential' by 40% of all consumers, contributing to the fact that 4% of the United States' GDP is for foodservice meals. Mr. Smith said that 23% of shoppers seeking seafood are confused with the products on display, with 19% giving up and walking away.

Turning to eating at home, Mr. Smith revealed that the person most responsible for preparing the family weekday meal is one of the children. Of these meals, only 30% are prepared from scratch. In addition to these direct physical acts, young people influence

78% of family grocery purchases and, conversely, spend $10 billion annually of their own money on food and beverages.

Sharing these statistics with the audience was for a specific purpose: to confirm one key reason for the success of the U.S. poultry industry is its recognition of consumer attitudes and its ability to respond to them. In other words, the industry, in the form of its suppliers, is delivering solutions, in the form of easy to prepare poultry dishes. The implication is that our domestic aquaculture industry must develop additional ways of providing similar meals to the consumer. For example, Mr. Smith said the United States has become the second largest Spanish speaking country in the world. What cuts and/or preparations of fish and crustaceans are being marketed direct to this growing consumer population? At the very least, fish market managers should have available recipes on how to prepare the various cuts of fish they offer.

Mr. Smith then turned to the early days of the poultry industry. It was after WW II, when feed stores served as the link between the fed mill and the poultry farmer. The farmer sold his production to local and/or distant auctions. The latter were usually located in large urban centers, where the birds were purchased by butchers. The end product, usually whole birds, was expensive and thus consumed only at the traditional Sunday meal. The complexity of this system proved cumbersome and expensive, and eventually resulted in its temporary collapse.

Rising from the ashes was a new system that leads to today's industry consisting of totally vertically integrated companies. The change was led by the feed stores. While, at least initially, they continued to buy feed from the feed mill and sell it to farmers, they evolved to buying back the production and to assume responsibility for delivery of the live birds to auction. The feed dealers soon realized the inefficiencies in this system and, over the years, developed the system we know today. One classical model is for the feed mill to supply feed as well as their hatchery stock to contract growers. The birds they receive back are processed through plants they own and shipped in their trucks to market. The processing aspect of the industry further evolved to today, where the whole bird is often further processed into parts and specialty meals and trucked directly to foodservices and large retail markets. As a result, chicken has evolved from a whole and expensive food served one per week to an inexpensive, ubiquitous necessity that can be consumed in hundreds of forms today.

The leaders in developing the poultry industry of today—the integrators—have developed brand names for which they have a large and loyal customer base. Such examples include Perdue, Pilgrims' Pride and Tyson. Retaining the loyalty of the company's existing consumers and seeking new customers has created strong competition among the integrators. This competition ensures a steady stream of new products and low prices.

Maintaining the good name of the company in the eyes of the public forces it to listen to the consumers' concerns. A recent example is the growing public concern over animal welfare, specifically the number of layers per cage. In this particular case, the United Egg Producers took the lead for the industry and developed an animal welfare program. It asked an animal scientist to form a committee of ethicists and scientists that were

totally independent of the funding source to develop science-based guidelines on the housing and handling of the hens. The findings included the recommendation that the density in each cage be set at 67 sq. in. or more depending on the breed of the bird. Those producers applying the new standards were issued a certification seal they could put on each package of their product.

Mr. Smith closed by noting that today, as a result of vertical integration, 42% of the poultry industry is controlled by only two integrators. These, plus an additional three integrators, control 61% of the market. Will the American aquaculture industry be as concentrated twenty years from now?

The next speaker was **Mr. Charles Conklin**, the owner of Big Brown Hatchery, Inc. in Effort, PA, and the President of the U.S. Trout Farmers' Association. He noted the U.S. trout industry's history dates back to the late 1800's, when its initial challenge was how to raise the fish in a controlled environment. Slow but steady progress accelerated in the 1960's when dry formulated feed found wide acceptance. Once it was confirmed that trout could be successfully raised in captivity, the next challenge was to determine the best methods to market it. The result was a bifurcation of the industry, with some producing trout for food, some for stocking and recreation (sports). Mr. Conklin represents the later and focused his presentation on this growing segment of the industry.

He emphasized the fact even an industry growing fish for non-food use has many challenges to overcome. In Pennsylvania, where his farm is located, PCB's found in some state waters require controls and testing in all state waters. Whirling Disease, found in Montana, caused a reaction in New York and, with it, additional inspections and controls in Pennsylvania. Most recently, and of greater impact, was the discovery of Viral Hemorrhagic Septicemia (VHS) in the Great Lakes. Its control has necessitated inspections by licensed veterinarians for a host of pathogens along with export permits issued by each state supplying the fish and import permits by each of the states receiving them. These rules and regulation, state and federally imposed, are costly and onerous, and represent one of the major challenges to operating a profitable business. Other local challenges include the effects of drought and flood, predators and invasive species.

Adding to such local concerns are the international anti-farm raised fish campaigns that harm all producers regardless of where they are located and the fish they grow. Examples include the inaccurate claims by certain environmental groups that farmed salmon have higher levels of mercury and PCBs than do wild-caught salmon. While these statements focused on a species other than trout, they nevertheless tainted the image of the entire farm-raised fish industry.

Turning to future concerns facing the industry, Mr. Conklin said water usage will become a limiting factor, the industry will need to produce more fish with less water, and the EPA's National Pollutant and Discharge Elimination System will probably become even more demanding. Similar increases in oversight are anticipated for invasive species controls and state and federal fish health regulations. Finally, the industry must begin to respond aggressively to the continuing and often inaccurate

claims of the environmentalist about the safety of farm-raised fish and the environmentally sustainable way in which our fish farms operate.

In spite of all these challenges and concerns, Mr. Conklin noted there is also some encouraging news, especially for his segment of the domestic trout industry. High on the list is the growing public recognition of the health giving value of Omega-3 in the diet. He noted that whereas the domestic growers of trout for food must compete with imports, especially for frozen cuts, the suppliers of trout for sports face competition only from other domestic producers. In addition, the demand for sports fish is growing.

Speaking next was **Mr. Randy Rhodes**, the President of Harvest Select Catfish Company, a firm that owns hatcheries, farms and processing facilities and a transportation fleet in both Alabama and Mississippi. Mr. Rhodes topic was "U.S. Catfish – Decade of Change". Mr. Rhodes noted that catfish, which ranked fifth in per-capita domestic consumption for several years, was replaced in 2006 by tilapia. Domestic consumption of catfish declined from a high of 1.137 lbs/capita in 2003 to 0.849 lbs. in 2009. Of serious concern to the industry is the fact that catfish imports, consisting of both Ictalurus and Pangasius, have soared from about one million pounds in 1996 to nearly 140 million pounds in 2010. In no small part due to these imports, the number of catfish farms and production has steadily declined. Farming operations in Mississippi, Alabama, Arkansas and Louisiana declined from a high of 933 in 2001 to 459 in 2010. Catfish acreage dropped from slightly over 180,000 acres in 2001 to a projected 90,000 acres in 2011. Between 2001 and 2011, the percentage decline in acreage was: Mississippi (51%), Alabama (21%), Arkansas (63%) and Louisiana (89%).

Mr. Rhodes noted the adverse effect of the decline in production and thus supply has been the drop in fish available for processing. For example, processing for 2009 ranged from a high of about 44 million pounds to a low of about 34 million pounds. For 2010, the range was similar: from 47 million pounds to 34 million pounds. However, for the first two months of 2011, the volume dropped from 35 million pounds in January to 26 million pounds in mid-February. Conversely, Mr. Rhodes noted, the price/pound to producers increased from slight less than $0.80 in 2009 to slightly over $0.80 in 2010. However, for the first two months of 2011, it increased to $0.95 - $1.05, all in live weight. This represents an increase over the same period last year of from $0.15 - $0.20/pound. However, while grower income is up, so is the price of feed, it increasing from slightly below $250/ton for feed containing 32% soybean meal (+/- $240 for 28%) in January 2006 to over $400/ton and $390/ton, respectively, for the same period in 2011. These increases are not necessarily good for the U.S. feed industry and thus the U.S. soybean grower and processors: between 2007 and 2010, feed delivery declined from nearly 700,000 tons to slightly over 400,000 tons.

What does the future hold for the domestic catfish industry? Mr. Rhodes said it depends on the individual producer. He noted banks are reluctant to approve loans lacking proof of positive cash flow. To this end, they are beginning to require a three year budget projection, including such information as the number of fish in the pond

each month, and the cost of growing them. They also want to know the projected per-pound income on fish sold and how it offsets the cost of projected production.

Mr. Rhodes closed by noting the industry will retrench and survive, albeit at a lower but more sustainable level of production. He predicts this level will be in the range of 375 – 400 million pounds, far less than the 660 million pounds of production in prior years. Contingent on this new, but more solid base of production will be the willingness of the consumer to accept the higher price she or he must pay at retail and/or when dining out.

The next speaker was **Mr. Bill Dewey**, the Manager of Public Policy and Communications for Taylor Shellfish Farms in Shelton, WA. The title of Mr. Dewey's presentation was "U.S. Shellfish Challenges and Opportunities". Mr. Dewey said the first of four challenges facing his company and the production of shellfish in the United States as being the Army Corps of Engineers' Nationwide Permit 48. Although issued in March 2007, it has yet to be implemented in the Pacific Northwest, and is resulting in inconsistent application in the other shellfish producing states. In addition, there are delays in ESA/MSA consultations and other certification requirements. One of the results of these bureaucratic inactions is that his firm is still waiting—after 15 years—to get a site license in Washington State. These delays have forced the company to purchase leases in Canada, where production has begun and 100 people employed.

Another reason for these delays is that the State of Washington's Shoreline Master Program is being updated. It includes new regulations on the growing of geoducks, a saltwater clam with which Taylor want to expand its production. Another reason for the delays is the vociferous opposition to any shellfish production by wealthy and influential home owners on land adjacent to Washington's coastal waters. The acronym for their opposition is BANANA: Build Absolutely Nothing And Not Anywhere!

Mr. Dewey described the firm's second challenge as the increasing concern for water quality. Those who consider shellfish production to be a contributor to decreased water quality seem to forget they are filter feeders that remove from, not add to, pollutants in the water.

The third challenge he described is the public health concern about Vibrio vulnificus, a bacteria that can be transmitted to humans from shellfish. Its control is resulting in additional regulations.

Mr. Dewey defined as the fourth challenge issues related to the international trade of shellfish. He noted the European ban on U.S. shellfish, implemented in July 2010, is still in effect. In contrast, the imports of frozen and cooked Manila clams from China are being sold in the United States at half the price of domestic production. He said one Chinese farm with which he is familiar produces more clams than his entire state, certainly more than the four million pounds annually produced by his firm.

Turning to opportunities for the industry, Mr. Dewey emphasized the possible implementation of the National Shellfish Initiative. Its objective is to increase the

production of shellfish; to restore coastal zones and improve water quality; and to increase investments, jobs and the domestic supply of seafood.

Related to this Initiative is the implementation of Marine Spatial Planning legislation, a bureaucratic term for zoning. Mr. Dewey considers this legislation to be of value as its implementation could clearly define where shellfish can be grown in the state, and ranked it as a second opportunity.

The third opportunity listed by Mr. Taylor is the open arms policy of Canada toward shellfish production. As he previously noted, Taylor has already purchased some sites, where it is in production and employing workers. The firm is considering the purchase of additional sites and will be partnering with First Nations as they expand shellfish production.

The next speaker was **Dr. Michael Rubino**, Manager of the NOAA Aquaculture Program in Washington, DC. The title of his presentation was "Present & Projected State of the Industry." Dr. Rubino confirmed that NOAA and the Department of Commerce (DOC) are looking to the future with the development of complementary draft aquaculture policies. Both policies underscore the importance of growing more seafood in the United States while protecting the integrity of the marine environment. The United States imports 84 percent of its seafood. Aquaculture is seen as an opportunity to take greater responsibility for seafood consumption decisions, create "blue-green" jobs from working waterfronts to the agricultural heartland, and offset the United States' 10 billion trade deficit in aquatic products. In reference to these draft policies, Dr. Rubino noted that the DOC proposal is more broadly based and oriented toward the Departments' business and economic mandates. Complementarily, the NOAA draft focuses on marine aquaculture production and science, regulatory, international, and education issues in the context of NOAA's marine stewardship mission. NOAA recognizes the value of input from stakeholders and the public and therefore is seeking advice during the comment period on priorities for action.

Dr. Rubino noted the NOAA draft policy provides a national approach to regulating aquaculture production in federal waters. After the close of the public comment period, NOAA's management has indicated that the agency will review the Gulf of Mexico Fishery Management Council's Fishery Management Plan for Aquaculture' in light of the final NOAA and DOC aquaculture policies and determine next steps. He also said the Western Pacific Fishery Management Council has discussed developing a plan for aquaculture.

Dr. Rubino indicated that NOAA's Aquaculture Program has engaged in a broad research agenda designed to advance the science and technology development to support sustainable domestic production. As an example, Dr. Rubino noted that the President's 2011 and 2012 budgets include a $2.4 million increase for aquaculture to work with USDA and industry to continue to develop alternative feeds. However, the final amount will depend on Congressional action and is not yet known.

NOAA presently is seeking public comment on both the Department of Commerce and the NOAA draft policies on aquaculture. Background, documents, and comment submission directions can be found on the NOAA Aquaculture Program website at http://aquaculture.noaa.gov. The public comment period closes on April 11, 2011. He strongly encouraged public input.

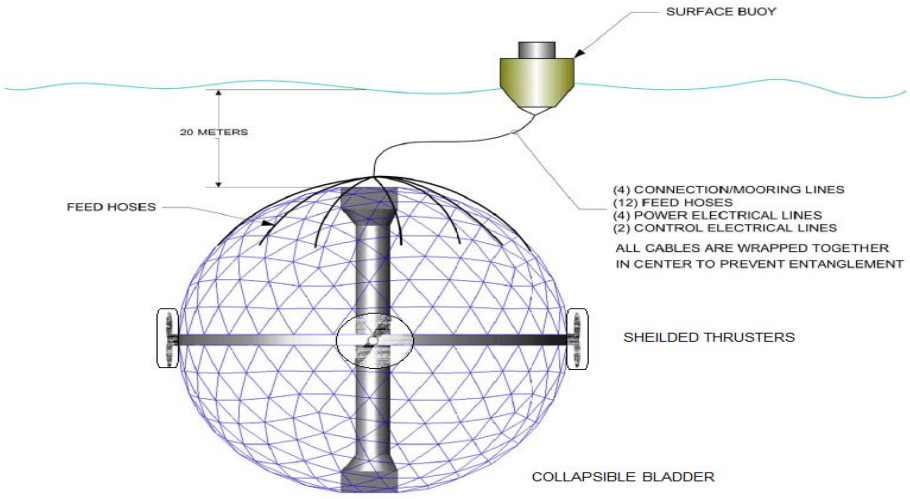
Finally, Dr. Rubino suggested the program's electronic newsletter as a vehicle to stay informed on developments with the policies and the program. One can sign up for the newsletter on the homepage of the NOAA Aquaculture Program website.

Speaking next was **Mr. Bill Spencer**, the CEO of Hawaii Oceanic Technology, Inc. The title of his review was "Hawaii Oceanic Technology, Inc. Pioneering Open Ocean Aquaculture in Hawaii". Mr. Spencer opened by noting that Hawaii sits in the middle of 69 million square miles of water defined as the Pacific Ocean. The series of islands that constitute the state are second only to Alaska in the size of its Exclusive Economic Zone (EEZ), and is the only state with laws allowing open ocean aquaculture. Unfortunately, the state and the federal governments have yet to resolve the question of where state waters end and federal waters begin. As a result, the licensing of some potential fish production sites may be delayed until this territorial issue is resolved.

Mr. Spencer reminded the audience of the importance of worldwide aquaculture. It has grown to a $100 billion industry that is presently supplying half of the world's seafood demand. It is an industry driven in part by the declining stocks and thus supply of wild-catch to meet the demand of a growing world population. For example, 32% of wild fish stocks are near depletion. The growth in population, coupled with more spendable income and popularity of fish indicates to some scientists that aquatic products must double in supply by 2020. It follows that increasing farm-fish production is critical to this success.

Turning to the work being done by his company, Mr. Spencer said it took two years to comply with the permit requirements, followed by three months of postponed decisions by the approving agencies. This was followed by an additional six months, during which opposition to the project was voiced and resolved. It is now six months later and though the main State permits and lease has been approved, an Army Corp Section 10 permit and Federal Consistency Review permit are still being processed.

Mr. Spencer described the Oceansphere, a large geodesic dome consisting of numerous hexagonal reinforced rods, each connecting to the other and to which a net is attached. The sphere can be automatically raised or lowered depending on sea conditions, with its lateral movement controlled by a series of thrusters attached to its sides. The sphere is connected to a 100 mt feeder buoy and a radio-controlled telemetry antenna for monitoring the feeder, the movement of the fish within the sphere, and to control the thrusters. The proposed 247 acre site will be located 2.6 nautical miles off Malae Point on Hawaii's Big Island, and will the only deep ocean aquaculture lease site in the United States. It is large enough to eventually support twelve Oceanspheres.



Mr. Spencer said Hawaii Oceanic Technology will be an "egg to plate" operation for growing ahi tuna, both yellowfin and big eye. The company will maintain brood stock and grow the fingerlings for transfer to the spheres. The grow-out phase is anticipated to take 14 months, with harvest on demand of up to 20,000, 80 – 100 pound fish per Oceansphere. They will be sold direct to markets in Japan and the U.S. mainland under the trade marked name of King Ahi™. The long-term goal of the company is to produce 6,000 mt of tuna per annum from the twelve spheres.

Mr. Spencer closed with a quote from Jacques Cousteau, "It's time to farm the ocean as we farm the land."

The next speaker was **Dr. Sebastian Belle**, the Executive Director of the Maine Aquaculture Association, and the President of Econ-Aqua, a private consulting firm. The title of his presentation was "Maine Aquaculture: Sustainable Solutions for Maine's Growing Future". Dr. Belle began by reminding the audience of the pending world food crisis, which will become increasingly critical as we approach a projected population of 9.6 billion people by 2050. Many will have a higher standard of living and will demand more animal-derived protein. However, there is growing concern that it will that this critical dietary requirement will become increasingly unavailable due to the decline in critical resources such as available land and water.

Dr. Belle confirmed one key factor in feeding the world will be the amount of aquatic food production, which he described as the "new frontier." He noted that 75% of the earth's surface is covered in water, in which growing aquatic products is a far more efficient way of producing protein for human consumption. Dr. Belle compared the efficiencies of various forms of animal protein production.

He noted that for each kilogram of flesh, the following kilograms of inputs are required:

	Feed	Water
Beef cattle	8	1,857
Swine	3	756
Chickens	2	469
Farm-raised fish	1.1	32

Turning to the world edible seafood supply, Dr. Belle said the wild-catch grew only marginally between 1991 and 1998. It has since has remained flat but expected to decline slightly by 2030. In contrast, the growth in aquaculture has been constantly upward from 1991 to today and, by 2030, is expected to account for 52% of the total edible seafood supply.

Placing the growing demand for aquatic foods, estimated to be 1.1 billion pounds by 2020 in a national context, Dr. Belle presented some troubling data for the United States. For example, over 80% of our seafood is imported, of which 59% is farm-raised. These imports rank second only to petroleum as a natural resource in its contribution to our present negative trade balance of $9.4 billion.

Dr. Belle then turned to Maine's long tradition of fishing and the future role it will play in aquaculture. He noted the farmer of the future will be a person raising seafood. He said the industry is already becoming established in the state, with 15 different species presently being grown in both on-land and off-shore locations. These include 26 sites for fish, 67 for shellfish, 10 for experiments and 96 for limited purposes. These production units provide jobs directly for 624 and indirectly for 380 workers. In 2010, the total farm gate sales from the sites were $96 million for fish, $8 million for shellfish and $3.5 million for freshwater production, a total of $107.5 million.

Turning specifically to Atlantic salmon production, Dr. Belle said the fish are raised in freshwater hatcheries for twelve months, then transferred to off-shore pens for 18-24 months. Upon harvest, they can move from "pen to plate" in less than 24 hours. To ensure a bright future for Maine's salmon industry, Dr. Belle said production methods are based on direct agreements with environmental NGOs and audited by independent third parties. All production comes under Cooperative Bay Management Agreements that require detailed environmental monitoring.

He noted these simple methods of production may change as the industry grows and becomes more diverse. This will result in an increased complexity and intensity of farm

management as the raising of multiple species will require more sophisticated production and marketing management practices. In regard to the former, it will require a better understanding of how each species affects the site where it is grown. For example, more consideration must be given to the ability of the site to support an increased volume of production of more diverse species of fish. This will require a more skilled work force and improved biosecurity to maximize sustainable production, to meet environmental standards and to enhance marketing opportunities.

Dr. Belle next provided a summary of the recently established Cod Academy established by the Maine Aquaculture Association. He said the program is based on successful models copied from Japan and Norway, and offers, at a demonstration farm, both theoretical and hands-on training. The program is challenging, competitive and requires a financial investment by each of the trainees. The majority of those enrolled in the program come from the commercial fishing industry. The program offers the participants an introduction to aquaculture, with emphasis on all phases of the cod production cycle. The trainees gain skills ranging from preparing a business plan to selecting a site and applying for an operating license.

He said the graduation requirements of the program are rigorous and include demonstrated knowledge of aquaculture in general and cod production in particular. Four specific requirements for graduation include: 1) development of a preliminary business plan; 2) compilation of a cod farming manual; 3) completion of a lease application; and 4) development of a cod farming economic model. Dr. Belle emphasized the students must learn to both ask and to research questions critical to the potential success of a future operation.

Returning to the future of the aquaculture industry in Maine, Dr. Belle said there are solid grounds for optimism. He noted the United States is the world's second largest market for seafood, with an additional 1.1 billion pounds required by 2020. It is a market that cannot depend on the wild-catch, and which is becoming concerned about the safety and security of its seafood imports. With 150 million customers within twelve hours of a fish production site, Maine can play an important role in providing more of this seafood.

Dr. Belle said Maine is reaching a critical mass by which it can meet this potential demand. This includes the increasing diversification of species, of new investments and of a sophisticated service sector. It includes a new aquaculture institute at the University of Maine/Orono that will contribute of what has become the most extensive research program in North America.

Dr. Belle closed by noting the many opportunities supporting Maine's aquaculture industry. They include the production of stocking and bait fish and the growing of Arctic Char in freshwater, and cod, halibut, scallops and sea urchin in coastal waters. Of equal importance is the building of an infrastructure dedicated to aquaculture, including the manufacturing of vaccines, pharmaceuticals and supplements. Other opportunities include aquatourism and the branding of Maine's aquaculture products under the generic title of "Sustainable Maine Seafood." A goal of Maine's aquaculture industry is "Keeping working waterfronts working."

The next speaker was **Ms. Karen Fear**, a soybean farmer from Montpelier, IN and a director with The United Soybean Board. Her topic was "Working Together: Soybeans and Aquaculture". Ms. Fear introduced herself as one of over 600,000 American soybean farmers who want to support the domestic aquaculture industry and, with it, to grow and be more profitable.

She said the United States continues to be the world's largest producer of soybeans, with a 2011 crop year projected harvest of 90.6 million mt, or 35.5% of the world total. In comparison, Brazil and Argentina will have a projected combined total of 118 million mt, or 46.1% of the total. Some reasons for the large U.S. crop, anticipated to be another record harvest coupled with a record yield of 44 bushels/acre. She noted soybean yields grew from about 20 bushels/acre in 1950 to over 40 bushels/acre in 2010.

She shared two graphs, one depicting projected U.S. and Argentine soybean exports to gain only marginally through 2015. In contrast, exports from Brazil should significantly increase. For soybean meal, U.S. exports are also projected to grow only marginally, albeit at lower levels than soybeans. Some export demand is projected for Argentina, with even more significant export growth for Brazil

Ms. Fear confirmed that the vast bulk of the U.S. soybean market is overseas because that is where the significant majority of fish and shrimp are grown. She noted that U.S. soybean farmers began promoting soy-based feeds in China almost 20 years ago. Today, China is the world's by-far largest customer for soybeans in general and soybeans used for aquaculture in particular. In contrast, our domestic aquaculture market is small and requires the support of everyone to help it grow. The United States needs to reduce its dependence on imported seafood, which represents 84% of domestic consumption and created in 2010 a $9.4 billion negative balance of trade.

She noted the estimated use of soy-based protein for all aquafeeds grew from about 2.4 million mt in 2005 to a projected 5.2 million mt, again as protein, in 2015. Another study estimated that seven million mt of soybean meal will be used in aquaculture in 2010.

Turning to the contribution of U.S. soybean farmers to aquaculture, Ms. Fear said that through the national soybean check-off they are investing nearly $4 million in 2011 in the United States in direct support of the domestic aquaculture industry. Of this amount, $1.6 million is to fund research and promotion. She divided this support into six categories, beginning with marketing and which, as described above, is primarily conducted outside the country. Finally, a new $1 million Aquaculture Initiative has recently been created and is in the development stage. All of this investment will contribute to the growth of our domestic industry.

For research, she said studies are being conducted to refine diet formulations of soybean meal, soybean oil and lectin in farm-raised marine shrimp, and to replace fish oil with stearidonic acid soy oil in Seriola. Work with cobia involves determining the optimal

combination of SPC and soybean meal to replace fishmeal, and to define the maximum inclusion ratio of soybean meal to soybean oil in California sea bass and yellowtail.

In regard to education, state soybean associations are being encouraged to promote the importance of aquaculture at their meetings and to describe to their congressional delegates how increased domestic fish and shrimp production can contribute to increased soybean demand.

Under the category of partnering with industry, some example Ms. Fear shared were conducting a jointly-funded outreach program with NAA, and providing leadership to The Plant Products in Aquafeeds program. She noted that ten meeting were conducted in 2010, with another seven to nine planned for 2011. All of these events are part of the "Four P's of a Safe and Sustainable Aquaculture Industry: Practice, Presentation, Promotion and the Press". Finally, USB is assisting NAA in funding a new NAA website. It will contain accurate information aimed at dispelling false statements about farm-raised fish, and can be accessed at www.theNAA.net. She said that all of these programs are examples of how soybean farmers are helping to build stronger the USB-Aquaculture Industry Coalition.

The final category of support described by Ms. Fear was industry competitiveness. With The goal of increasing the competitiveness of U.S. soybeans, the QUALISOY™ program was established. It is a collaborative effort with the soybean industry to develop a better quality soybean that will reduce the environmental impact of livestock, including fish and shrimp, which consume them. The Global Opportunities Program ensures the U.S. soybean industry continually strives to develop and implement a strategic view of the global soy marketplace and to respond proactively to it.

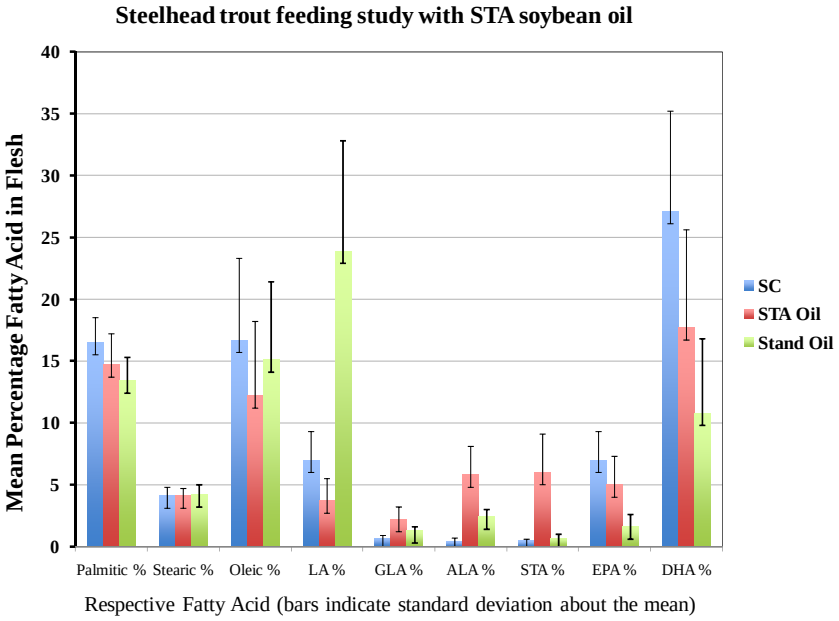
Ms. Fear closed her presentation by confirming the overall objectives of American soybean farmers are to expand overseas markets, build domestic demand and become more competitive. She said we also want to build stronger our domestic markets. She noted we all agree it is far from what it could be and needs all of our support to make it grow. To ensure that far less than the 84% of seafood we import is grown domestically; to bring down our negative trade balance of $9.4 billion for seafood to a more reasonable level; to ensure we provide more jobs, more food safety, and security; and to ensure your business of growing fish and her business of growing soybeans have a brighter future.

Opening the Aqua Feeds Update session was **Dr. Tom Clemente**, a Professor in the University of Nebraska's Department of Agronomy and Horticulture/Center for Plant Science Innovation, where he serves as the Manager of the Plant Transformation Core Research Facility. Dr. Clemente's presentation was entitled "Sustainable Aquaculture: Think Soybeans". The presentation outlined a biotechnology strategy for the production of high omega-3 fatty acids and the synthesis of the high value carotenoid, astaxanthin, in soybeans. The long-term goal is to test develop a soybean-based feedstock for aquaculture.

One of the omega-3 fatty acids being produced in soybean is stearidonic acid (STA). Studies were communicated that addressed the question can steelhead trout metabolize STA to the very-long chain omega-3 fatty acids EPA and DHA, hence, productive a means to displace fish oil in aquaculture feeds with a sustainable land-based source. Diets were formulated and evaluated containing non-fish source proteins and using STA soybean oil, standard soybean oil or fish oil as the lipid source. The findings revealed that indeed steelhead trout can metabolize STA to the nutritional important fatty acids EPA and DHA. The data are summarized below

The total amino acid profiles and proximate analysis of the feed and the fatty acid profile of the steelhead trout were:

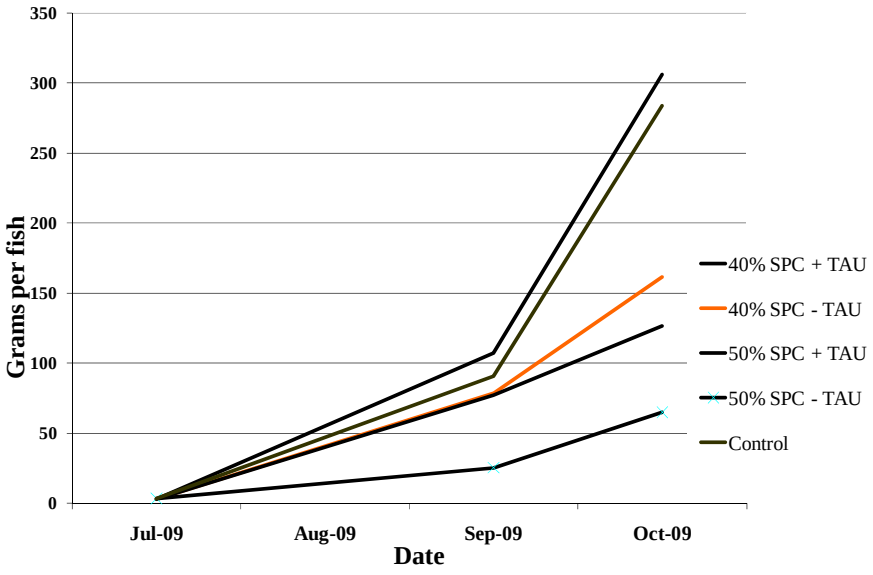
AA	"All Soy"-STA		Commercial	
W/W%	2 mm	3 mm	2 mm	3 mm
Taurine	0.0	0.0	0.5	0.3
Hydroxyproline	0.0	0.0	0.5	0.1
Aspartic Acid	5.7	5.7	4.4	3.8
Threonine	1.9	1.9	1.9	1.7
Serine	2.1	2.2	1.6	1.6
Glutamic Acid	7.8	7.9	6.6	8.1
Proline	2.3	2.3	2.3	2.9
Glycine	2.2	2.2	3.3	2.9
Alanine	2.6	2.5	3.1	3.6
Cysteine	0.8	0.8	0.5	0.5
Valine	3.0	2.7	2.6	2.6
Methionine	0.7	0.7	1.3	1.8
Isoleucine	2.0	1.8	2.2	2.2
Leucine	4.6	4.5	3.8	5.1
Tyrosine	1.7	1.7	1.6	1.9
Phenylalanine	2.7	2.6	2.1	2.5
Lysine	3.9	3.8	3.8	4.2
Histidine	1.8	1.8	1.4	1.4
Arginine	3.4	3.4	2.8	2.5
Tryptophan	0.4	0.4	0.5	0.5
Crude protein	51.4%	51.2%	50.3%	52.4%
Moisture	5.4%	5.3%	7.8%	6.1%
Crude Fat**	16.3%	20.5%	19.0%	18.9%
Crude Fiber	1.0%	0.8%	0.2%	0.5%
Ash	5.6%	5.3%	12.5%	9.0%



The presentation then went on to outline analogous studies with the fin fish Kona Kampachi™ to ascertain if this Seriola species can metabolize STA to EPA and DHA. The data revealed that unlike trout, Kona Kampachi is only capable of elongating STA, with out further metabolism to EPA and DHA. However, during these studies it was observed that this fin fish performed poorly on a primarily plant based protein diet. As a follow-up to work conducted on a related Seriola species (Hamachi), which found some fin fish appear to be like cats, wherein there is a requirement for the "non-essential" amino acid taurine, a feeding trail was conducted where a 5% supplement was added to either a 40% or 50% SPC-based protein diet. The data revealed that with 5% taurine and 40% SPC protein displacement, it possible to reduce fishmeal levels below 12%, without compromising growth rates or FDC (see below). Importantly, with the 5% taurine supplement, and 40% SPC diet we were able to demonstrate that blending of fish oil with STA soybean oil (50/50 blend), it is possible to produce a harvestable size fish with more total omega-3 fatty acids than the commercial diet that provides lipid through 100% fish oil.

Ingredient	Control	40% SPC w/taurine	40% SPC w/out taurine	50% SPC w/taurine	50% SPC w/out taurine
SPC	0.00	40.0	40.0	50.0	50.0
Fish meal	56.15	11.89	11.89	1.89	1.89
Potato starch	13.20	7.42	7.42	6.06	6.06
Fish oil	13.81	17.30	17.30	17.99	17.99
Squid meal	4.40	4.40	4.40	4.40	4.40
Blood meal	2.00	6.07	6.07	6.74	6.74
Taurine	0.00	4.60	0.00	4.60	0.00
Cellulose	0.00	0.00	4.60	0.00	4.60
Soy lecithin	1.50	1.50	1.50	1.50	1.50
Vit Premix	0.50	0.50	0.50	0.50	0.50
Stay-C	0.06	0.06	0.06	0.06	0.06
Choline Cl	0.00	0.29	0.29	0.29	0.29
Mineral Premix	0.25	0.25	0.25	0.25	0.25
Ca Phosphate	0.00	1.50	1.50	1.50	1.50
Ca carbonate	0.05	0.01	0.01	0.01	0.01
L-lysine	0.00	0.35	0.35	0.35	0.35
MHA	0.00	0.38	0.38	0.38	0.38
Ethoxyquin	0.02	0.02	0.02	0.02	0.02
Mold Inhibitor	0.02	0.02	0.02	0.02	0.02
Fish, HFPC	8.04	3.44	3.44	3.44	3.44

Takagi et al 2008 Aquaculture 280:198



The total amino acid profile and proximate analysis of the feeds, with emphasis on the inclusion of taurine, was:

AA W/W%	FO	Soy/FO	STA/FO
Taurine	5.2	5.3	5.3
Aspartic Acid	5.4	5.9	5.6
Threonine	2.0	2.1	2.1
Serine	2.3	2.6	2.6
Glutamic Acid	8.0	8.8	8.7
Proline	2.2	2.4	2.4
Glycine	2.4	2.6	2.6
Alanine	2.6	2.7	2.7
Cysteine	0.6	0.6	0.6
Valine	2.5	2.7	2.7
Methionine	0.9	0.9	1.0
Isoleucine	1.9	2.0	2.0
Leucine	4.2	4.5	4.5
Tyrosine	1.5	1.5	1.6
Phenylalanine	2.4	2.5	2.5
Lysine	4.0	4.2	4.0
Histidine	1.6	1.7	1.7
Arginine	3.6	3.6	3.7
Tryptophan	0.6	0.6	0.6
Crude protein	53.3%	50.9%	50.2%
Crude Fat**	19.1%	18.8%	17.4%
Ash	6.6%	6.6%	6.6%
Peroxide value	98 meq/kg	23 meq/kg	23 meq/kg

Future studies ongoing in 2011 include two additional experiments with Kona Kampachi ™. One will be a grow-out, using shore tanks containing 40% SPC, STA/FO and a Skreeting diet. The other will be a short term growth test that will like at displacing more fish oil. There will be, in collaboration with Dr. Dick Perrin at the University of Nebraska/Lincoln, an economic analysis on a feed formulation containing 40% SPC with various soy oil blends. In addition, the design and evaluation of an algal-based feedstock for the production of taurine will be conducted.

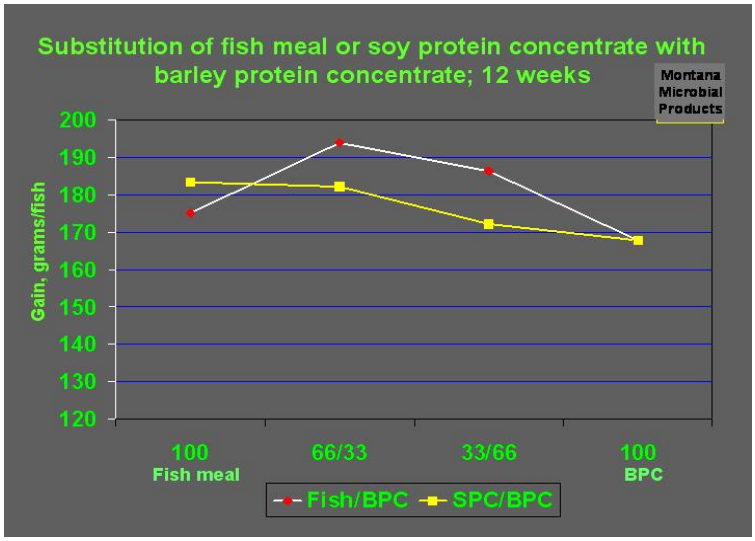
Speaking next was **Dr. Rick Barrows**, Lead Scientist with the USDA/ARS Trout-Grains Project at the Bozeman Fish Technology Center in Bozeman, MT. The title of his presentation was “Alternative Ingredients for Aquafeeds”. Dr. Barrows said his lab conducts five tests—compositional analysis, palatability, digestibility, functionality and growth to determine the nutritional and economic value of an ingredient. The compositional analysis determines the content of nutrients such as protein, energy, amino and fatty acids and any possible anti-nutrients such as trypsin inhibitors. The palatability test determines the effect of the test ingredient on feed intake. The digestibility test defines the apparent digestibility coefficients for major nutrients and amino acids. The functionality test determines the effect of the test ingredient on durability, expansion, and oil absorption and water stability of extruded feed pellets. The growth test defines the FCR, gain in weight, fecal production and product quality.

He then presented results from tests on three ingredients with high potential for commercial application in aquafeeds for carnivorous fish. The three ingredients reported were barley protein concentrate, Spirulina (an algal-source protein) and improved varieties of soy.

Dr. Barrows said his research with barley protein concentrate, ranging from ~51% to ~55% protein, revealed no problems with palatability. The apparent digestibility coefficients, in percentage, were:

	Dry Matter	Protein	Fat
Reference Diet	76.3	86.6	98.3
BPC	97.3	99.1	99.0
Krill	85.0	84.4	99.1

The results of the feeding trial were:



Turning to his research with Spirulina, Dr. Barrows said it was an algae produced in ponds and solar dried. It had a crude protein content of 62% - 72% crude protein, crude fat of 0.5% – 2.1%, and an ash content that depended on the effectiveness of rinsing the saline waters. It was grown and dried under the ideal conditions found in the Imperial Valley of California. The area has significant amounts of fallow land, 365 days of sun, adequate irrigation water, the availability of both a skilled and unskilled workforce, and could support a source of production of up to 50,000 acres. Dr. Barrows showed a slide of two existing concrete lined production ponds, each with paddle wheels to circulate

the water. They are part of Imperial Aquafeed Corporation's facility which provided the Spirulina meal for the feeding trial. One contained Duniella, a winter crop species of algae used as an oil source. The other contained Spirulina, a summer crop of algae used for protein.

The palatability trial with Spirulina (provided by the Imperial Aquafeed Corp.) revealed it had a significant positive effect on feed intake. The apparent digestibility coefficient, in percentage, was:

	Dry Matter	Protein	Fat
Reference Diet	76.3	86.6	98.3
Spirulina	77.8	80.5	96.0
Soybean Meal (48%)	75.3	85.8	98.1

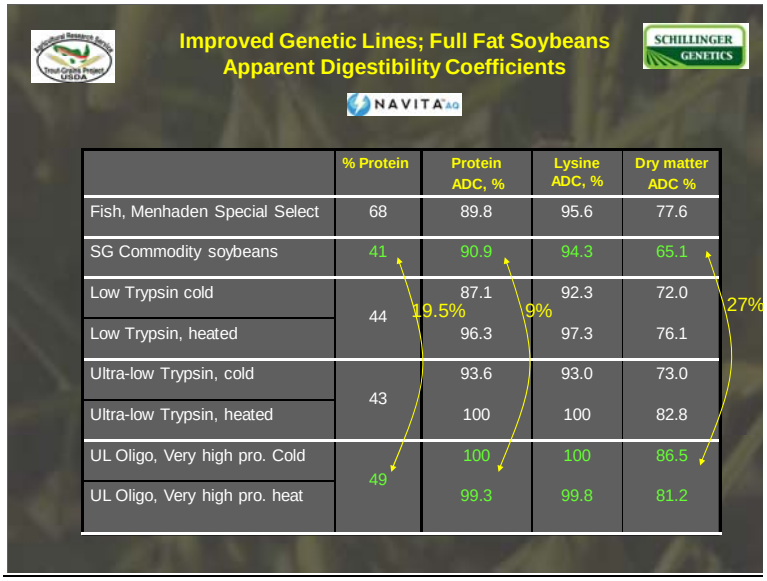
In regard to functionality, he noted there were dramatic expansion, increased pellet durability and increased oil absorption capacity.

Dr. Barrows also presented the results of the feeding trial, conducted in cooperation with Hubb's Sea World Research Institute. The effect on eight weeks of growth on White Sea bass, in which a base formula was used, confirmed the addition of Spirulina meal in the fishmeal free ration increased the percent of weight gain significantly from an increase of 10% to 20% and again from 20% to 30% in inclusion rate. Conversely, when added to the fishmeal based diet, there was a decline from both inclusion rates.

For the rate of survival, the results were similar for the fishmeal free diet, while demonstrating no effect on the fishmeal diet. In regard to feed efficiency, the results were similar, albeit less dramatic in the fish meal free diet, and reflected a decline from 20% to 30% in the fishmeal diet.

The third ingredient tested by Dr. Barrows was improved lines of non-GMO soybeans provided by Schillinger Genetics. Dr. Barrows said that of the twelve varieties tested, most had no effect on feed intake in the palatability trial. In regard to functionality, he noted the pre-processing of the meal seemed to affect pellet durability and expansion when comparing heated to cold pressing. He also indentified differences in varieties, and observed a major difference in oil absorption among them.

In regard to the apparent digestibility coefficients, Dr. Barrows provided the following data:



	% Protein	Protein ADC, %	Lysine ADC, %	Dry matter ADC %
Fish, Menhaden Special Select	68	89.8	95.6	77.6
SG Commodity soybeans	41	90.9	94.3	65.1
Low Trypsin cold	44	87.1	92.3	72.0
Low Trypsin, heated		96.3	97.3	76.1
Ultra-low Trypsin, cold	43	93.6	93.0	73.0
Ultra-low Trypsin, heated		100	100	82.8
UL Oligo, Very high pro. Cold	49	100	100	86.5
UL Oligo, Very high pro. heat		99.3	99.8	81.2

He described the results of a 12 week feeding trial with trout using full-fat soybean meal as follows:

Soy Variety	Type/Inclusion Levels	g gain/fish*	% Gain	FCR
SG Commodity	hot 15%	101.5	1064	0.78
SG Commodity	hot 30%	100.3	1052	0.80
Low Trypsin	hot 15%	100.9	1069	0.81
Low Trypsin	cold 15%	103.3	1093	0.78
P34, Allergen Free	hot 15%	99.0	1018	0.78
P34, Allergen Free	hot 30%	93.8	973	0.84
High Protein ULO	hot 15%	102.7	1090	0.75
High Protein ULO	hot 30%	100.8	1050	0.74
High Protein ULO	cold 15%	100.8	1038	0.79
High Protein ULO	cold 30%	104.3	1078	0.81

He said additional trials will be conducted in 2011 with rainbow trout, Atlantic salmon, cobia, and Kona Kampachi.

Dr. Barrows closed by stating that the high value alternative feeds to fishmeal are being developed, and are available for commercial scale testing. However, he reminded the

audience, all of the characteristics of the ingredients must be considered to determine their actual nutritional and economic value.

Speaking next was **Diane Bellis**, the Director of Federal Research Programs for AgSource, Inc. in Washington, DC. The title of her presentation was "Beyond the PPA". She opened by emphasizing two important conclusions of a group representing state and national soybean check-off organizations and aquaculture producers that met last July : that the underlying economic fundamentals as well as the underlying environmental and sustainability fundamentals are in place to support a viable aquaculture industry in the U.S. The same group concluded that, the key barriers that remain are technological and regulatory. The goal of the PPA (Plant Products in Aquafeed) program is to work to resolve the technological barriers and provide the scientific basis for resolving regulatory impediments. She said the six-year old program has been instrumental in creating new relationships among researchers and the industry, resulting in new project with a more strategic focus. She defined the goal of the PPA as "A framework to coordinate research, exchange data, and establish standards for research on plant-based aquafeeds".

Dr. Bellis noted the PPA program is far from being alone in the critical effort being made to ensure the future of the domestic aquaculture industry. Others include the NOAA-USDA Alternative Feed Initiative on the Future of Aquafeeds which published the draft NOAA and DOC aquaculture policy, the NOAA/NIST report on "Overcoming Technical Barriers to the Sustainable Development of Competitive Marine Aquaculture in the United States", the White House's Joint Subcommittee on Aquaculture, and the recent release of the National Research Council's "Nutrient Requirements of Fish and Shrimp". Many of these documents, she noted, recognize the need to coordinate their research effort due to increasingly limited resources. They also recognize the need for focusing research on those with the greatest potential for success.

Dr. Bellis then shared an example from our soybean industry that has direct application to our aquaculture industry. She said soybean farmers realized several years ago the need to sequence the soybean genome. Among other characteristics they wanted to know how genes affect factors including from yield to protein content. In no small part due to their support for such research, there are now soybeans available with increased protein, reduced carbohydrates, null for anti-nutritional factors and high in Omega-3. These soybeans bring value to both the soybean farmer who grows them and to the fish farmer who uses the soybean meal in his or her fish feed.

Turning to aquaculture, Dr. Bellis said there is an equally important need to improve understanding of the genetic basis of traits key to production aquaculture. In brief, it makes no more sense to grow wild fish than to grow wild soybeans. .

She concluded by noting that despite the challenges of fish nutrition research, many individuals and entities are appreciating the importance of basic research to resolving the technological barriers. Fortunately, and through the hard work of many researchers, a new focus is developing. To this end, the basic premise on which the PPA program established has not changed. What is "Beyond PPA" is a broader approach to reduce

reliance on both fishmeal and fish oil in aquaculture feeds while maintaining the high protein and healthy oil profiles of farmed seafood. This change reflects both the close working relationship with NOAA and USDA and the growing research community.

Dr. Bellis said another important step in this evolution is the joint PPA, NOAA, and USDA workshop that will take place in August 2011 to develop a strategic research plan for improving fish genetics and for developing comprehensive and adaptable "knowledge-bases" that will allow integration and sharing of current knowledge and foster continuous improvements in productivity for aquaculture. Sixty international experts on genomics and bioinformatics will be invited to the workshop. She closed her presentation by expressing appreciation to Jeff Silverstein and Mike Rust Rick Barrows for this collaboration with PPA and especially to Delbert Gatlin and Rich Barrows for chairing PPA

Speaking next was **Dr. Michael Rust**, the Aquaculture Research Program Manager at NOAA's Northwest Fisheries Science Center in Seattle, WA. Dr. Rust's topic was "The NOAA/USDA Feeds Initiative", on which he provided a detailed summary. He recognized the contribution of the 18 federal managers and researchers, university researchers and private company representatives who served on the steering committee. He said the purpose of the initiative was "...to provide a cost-effective alternative dietary ingredients for aquaculture that will reduce the amount of direct capture fishmeal and fish oil contained in aquaculture feeds while maintaining important human health benefits of farmed seafood and have a small environmental footprint". In his view, the objective has a "triple bottom line": economic, environmental and health.

Dr. Rust confirmed why fishmeal is considered the gold standard for aquacultural feeds. It has both a correct amino acid balance and fatty acid profile; it is easy to supplement with vitamins and contains no anti-nutrients; and it is produced from well-managed fisheries. And, from the viewpoint of the initial consumer—the fish—it tastes good! However, fishmeal and fish oil are a finite resource that is already being fully utilized.

He described the approach of the study as being to highlight both the existing research on alternative feed ingredients and case studies of successful technology transfer. This information will be used to identify future research and development projects and rank them in importance. Finally, the study will address public misconceptions surrounding aquaculture feeds. Dr. Rust said both the input and information consolidation phases of the study are complete, with the public review to end on March 18, 2011. The final report and action plan is anticipated to be completed with the next 18-24 months. However, the draft study is presently available and can be downloaded on **aquaculture.noaa.gov.**

Dr. Rust provided details on 20 finding listed in the report. They, along with selected examples of proposed research and key points are:

1. Fishmeal and fish oil are not nutritionally required for farmed fish to grow.

A better understanding of the species-specific requirements of fish and their performance using alternative feeds is needed.

2. Farming of fish is a very efficient way to produce animal protein and other human nutritional needs.

Farmed fish is a highly efficient converter of feed to flesh, especially in comparison to terrestrial animals.

3. Feed manufacturers making diets for carnivorous fish and shrimp have already reduced their reliance on fishmeal and fish oil.

Over the past 15 years, the fish in: fish out ratio has declined from 3-4:1 to 1.5:1 due to the effective and increasing inclusion of alternative feed ingredients. In contrast, fishmeal and fish oil are increasingly being reserved for broodstock, larval and finishing diets.

4. Economics is currently the major driver of using alternative feed ingredients in feed mills.

The study panel confirmed the lack of sufficient information on the species-specific nutritional requirements of fish and shrimp, thus limiting the ability of feed manufacturers to provide them at a competitive price.

5. The net environmental effects of the production and use of alternative feeds should be considered.

6. The human health implications of using alternative feeds needs to be better understood and considered.

7. Fishmeal and fish oil are minor contributors to the world protein and edible oil supply.

A four percent increase in the present world supply of soybeans would provide almost as much protein as did, in 2007, fishmeal. Based on improvements through better management practices, cultivars and yield, the increase in soybean-based protein has equaled total fishmeal-based protein about every five years, and without any increase in cultivated land.

8. Recovery and utilization of fisheries processing waste should be encouraged and increased.

Research is needed on how to convert waste products from wild-catch and farm-raised fish processing. This supply could equal the amount of fishmeal and fish oil presently produced directly from the capture and processing of feed fish.

9. Plants produce the vast majority of proteins and edible oils in the world, accounting for 94 percent of total protein production and 86 percent of total edible oil production.

Research aimed at creating more and improved plant-based aquaculture feeds will enhance the link between agriculture and aquaculture, to the benefit of both industries.

10. Algae-based biofuels may present opportunities for feed ingredient production because protein is a byproduct of oil recovery from algae, and marine algae produce the long-chain omega-3 fatty acids and certain amino acids important to fish and human health.

Although too early to determine the nutritional benefits of algae-based feeds, research on producing omega-3 alone is considered of value.

11. There will likely be increased demand for ethanol and bioplastics. Byproducts from these industries could make good ingredients for fish diets.

Research is needed to determine ways to not degrade and to convert the waste products of ethanol and biodiesel production to proteins that can be used in aquaculture feeds.

12. As replacements, many alternatives are higher in cost per unit fish gain (biological value) than fishmeal and fish oil.

13. Fish have dietary needs and preferences for specific compounds not found in plants, so there is a need for specialized products that supply these product and/or add flavor to the diet.

Research is needed on such nutrient sources as algae, invertebrates and animal by-products to determine if they can economically contribute to the dietary needs of fish and shrimp.

14. Alternative sources of protein and oil are common commodities used in livestock and companion animal feeds and come from novel byproducts, from other industries underutilized resources, or completely novel products.

More work is needed on novel byproducts, such as proteins recovered from biofuel production, and new products, such as meals produced from worms, insects and marine invertebrates.

15. Plants and other proteins contain some compounds (anti-nutrients) that are detrimental to fish.

Further research is needed not only to remove anti-nutritional factors found in, for example, soybeans, but to breed fish that can metabolize them without any adverse effect on growth and mortality.

16. Harvest of lower trophic species, such as krill, for fishmeal and oil production may be possible, but the environmental benefits afforded to the marine ecosystem from these species should be considered along with the economic and nutritional aspects of their use.

Harvesting the wild population of krill, a critical link in the aquatic animal food chain in colder, ocean waters, must be done with caution and under strict management controls.

17. The use of bycatch for the production of fishmeal and fish oil could provide a substantial amount of these products without increasing the current impact from the wild capture fisheries.

While the increase in fishmeal and fish oil from improvement in bycatch processing is desired, caution is encouraged in creating a market for non-target species.

18. Demand for long-chain omega-3 fatty acids for both direct human consumption and feed ingredients is likely to increase beyond the amounts available from marine resources.

Further research is needed to create new and cost-effective ways to produce long-chain omega-3 fatty acids due to their health-giving properties for humans.

19. Farmed fish species are being increasingly domesticated and performance is improving through conventional genetic selection and selection for performance on plant-based and other non-fish based aquafeeds.

20. Scientific information on the nutritional requirements of farmed fish species, and feed ingredients, and the interaction between the fish and the diet, will need to expand greatly to make substantial improvements in feed formulation by commercial aquaculture feed producers.

The regular updating of the National Research Council's "Nutrient Requirements of Fish and Shrimp" is of value.

Dr. Rust closed by encouraging the audience to obtain a copy of "The Future of Aquafeeds Study".

The closing speaker was **Dr. John Buchanan**, the Director of Research and Development for AquaBounty Technologies in San Diego, CA. Dr. Buchanan's presentation was entitled "AquaBounty's AquAdvantage® Salmon". He described the fish as an Atlantic salmon genetically engineered for rapid growth. He said it will

improve productivity and thus the economics of commercial aquaculture, and will contribute to making its land-based culture profitable. He said the application of biotechnology to aquaculture is important because farm-raised fish production must at a minimum triple by 2030 to ensure today's per-capita supply of fish for tomorrow's increased human population. The wild-catch, already overexploited in various environments, cannot meet this demand. As a result, the production of fish, an efficient source of animal protein, must be rapidly increased beyond the abilities of present production methods. Biotechnology, through which fish can be grown more rapidly, is critical to meeting this demand.

Dr. Buchanan said his firm focused on Atlantic salmon because it is the major cultured finfish in the world due to its popularity and explosive growth in supply. For example, of the 25,000 mt of salmon consumed in 1982, 13,000 were farm-raised. In comparison, the supply of Atlantic salmon in 2007 soared to 1,403,000 mt, of which only 3,000 were from the wild-catch. Of the Atlantic salmon consumed in the United States, 97% is imported. These are fish that contain high levels of the health-giving omega-3. With the goal of reducing production costs, increasing productivity and alleviating environmental impact, the AquAdvantage® salmon was developed.

He said the firm's biotech-enhanced salmon is the result of adding a growth-hormone gene from the Chinook salmon to the Atlantic salmon genome. Stitched to this gene is a promoter from the ocean pout; a promoter is a switch that turns genes on or off. This promoter-gene combination produces salmon growth hormone year round, resulting in faster growth, especially in winter months. The gene was injected into Atlantic salmon eggs in Garth Fletchers laboratory in St John's, Newfoundland. The fertilized eggs were screened, with the fastest growing fish that grew from them removed for further testing. This F_1 generation was tested over nine generations, from 1998 to 2006, to confirm the molecular-genetic integrity of the transgene and the heritability of the AquAdvantage® phenotype. The results of a growth comparison study revealed the following:

Days to Reach Test Weight from Smolts
(grams)

	100	200	500
AquAdvantage®	140	180	240
Standard St John strain Salmon	290	360	420

Further growth studies, which included both the smolt and grow out stages, revealed the AquAdvantage® salmon's growth and size advantage over the standard salmon was 230 days for up to about 4 kg. However, the optimal size for maximum cost benefits, primarily due to rapid growth of the transgenic fish during the smolt stage may be 1 kg. In brief, AquaBounty's fish is engineered to grow faster, not larger. It will grow from egg to harvest in about half the time of a standard salmon, while demonstrating a ten percent improvement in feed utilization.

Dr. Buchanan then turned to another, but equally demanding, challenge: to work through the regulatory process to get the fish approved for public consumption and without being labeled as GMO. He described the FDA's "Regulation of Genetically Engineered Animals Containing Heritable Recombinant DNA Constructs" and the multitude of regulatory and target animal studies the firm was required to conduct. He summarized the nutritional and hormonal studies developed from the composition of over 70 salmon using 4,000 data points. In regard to both of these studies, it was revealed there were no significant differences between filets of the AquAdvantage® salmon and commercially farmed salmon.

Dr. Buchanan closed his presentation by summarizing the FDA's findings relevant to composition. The agency said AquaBounty's salmon met the standard of identity for Atlantic salmon established by FDA's "Reference Fish Encyclopedia". In addition, no biologically relevant differences were detected in the levels of the gene product, or any endogenous metabolite or substance found in physiological pathways that could be impacted by that hormone. It noted the salmon contained the expected amounts of both omega-3 and omega-6 fatty acids. In brief, it found no biologically relevant differences between food from AquaBounty's salmon and conventional Atlantic salmon. In other words, the AquAdvantage® salmon is as safe to eat as food from other Atlantic salmon.

Mr. Griffis closed the meeting by thanking the speakers and guests for their participation. He announced the eight annual USB-Aquaculture Industry meeting will take place during the Aquaculture America 2012 meeting in Las Vegas.