FINAL 4/06

WORK GROUP 11
Research Forum
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Silver Spring, Maryland

Participants:
Meryl Broussard (USDA/CSREES), Betsy Hart (National Aquaculture Association), Fred Kern (NOAA), Jim McVey (NOAA), Andy Goodwin (Univ. of Arkansas, Pinebluff), Scott LaPatra (Clear Springs Foods), Jeff Lotz (Univ. So. Mississippi), Lew Smith (USDA/ARS), Stephen Smith (Virginia Tech. Univ.), Robin Schrock (Interior/USGS), Janet Whaley and Kevin Amos (NOAA/NMFS), Guppy Blair (US Fish and Wildlife Service), Jill Rolland and Gary Egrie (USDA/APHIS),

Agenda:
1) Introduction to the National Aquatic Animal Health Plan (NAAHP) – Jill Rolland.

2) Goals of the Research Forum – Kevin Amos

3) JSA Research and Technology Task Force – Meryl Broussard
The National Science and Technology committee (NSTC) is becoming more engaged in the Joint Subcommittee on Aquaculture's (JSA) business. The research agenda is an important topic. NSTC wanted a strategic plan for R&D early on (original JSA strategic R&D plan submitted in 1994). The new research and technology task force of the JSA is charged to update the R&D plan and to enhance interagency cooperation and collaboration. Questions that need to be addressed - Have industry needs changed or stayed the same? What needs to be done?

How are these strategic plans used? R&D plans are used as a blueprint and elements of the R&D plan match up with agency plans. Page 7 of the 1994 R&D strategic plan refers to integrated aquatic animal health management. There are no pathogen lists – they are more overarching needs that need to be addressed. R&D plan needs to be aligned with the national aquatic animal health plan (NAAHP).

When proposals are submitted, CSREES sends a copy of the strategic plan to principal investigators to ensure they are addressing the elements of the strategic plan in their proposal.

How will the NAAHP interact with the research and technology task force? Research needs will be identified by this work group (and other stakeholder meetings) that can feed into the new task force that is working on updating the R&D plan. We want to be responsive but we also need to be broad based. We also will work within the context of the new JSA R&D subcommittee.

There will be good linkage between task forces since some people will be members of both to ensure communication.

The old R&D plan will serve as a template – it will not be entirely changed, just updated to reflect new needs. The marketing and economics section will need attention.

We have good interaction with the Office of Science Technology and Policy (OSTP) and good visibility.

The new task force is currently active, but has not formally met. Meryl Broussard and Kevin Amos are on both the NAAHTF and the new research and technology task force and can serve as a liaison between the two.

A two-year time line is expected to update the R&D plan. OSTP has a new handbook that outlines how work products produced under OSTP are to be formally reviewed. As the NAAHTF identifies research needs through working groups, etc., this information would be fed into the research and technology task force.

National Aquaculture Development Plan – action items identified and roles of Federal agencies identified. Roles of Federal agencies in the R&D plan were never identified to prevent bogging the process down and to keep the R&D plan broad-based. A 1980 MOU between Interior, Commerce and Agriculture identifies major areas of aquaculture interest (freshwater, marine, recreation). Federal agencies have broader mandates and scope and are, therefore, not using the MOU as a guiding document. USDA's focus is on commercial aquaculture. NOAA's focus is still marine aquaculture, private and public. Currently there is an MOU in place between Interior, Commerce and Agriculture on aquatic animal health export certification. In the works is a broader MOU between the three agencies on cooperation on aquatic animal health issues.

4) Review of Federal agencies' research programs (presentations by agency representatives)

Interior - US Geologic Survey (USGS) and US Fish and Wildlife Service (FWS)
Robin Schrock – US Geologic Survey (USGS) research in aquatic animal health. (PPT attached as a separate document).

Guppy Blair – US Fish and Wildlife Service (FWS) works with USGS to address research questions. A portion of USGS research funds go to meeting FWS needs. FWS personnel may be project leads or some work may be carried out at FWS fish health centers, but USGS personnel and facilities conduct primarily the work. Science support can be carried out at the FWS fish health centers or the fish technology centers. Research at fish health centers is more at the field level. The FWS regions drive research priorities.

FWS is implementing a data retrieval system where managers can enter research needs so that needs could be identified by multiple people/areas and coordinated and prioritized to ensure that the same research isn't being conducted in multiple locations.

Fish nutrition work in Interior/FWS is being carried out at the fish technology centers.

Commerce – SeaGrant, NOAA Fisheries
Jim McVey – NOAA/SeaGrant – 31 State programs. SeaGrant is a $60 million program nation-wide. The focus is on research as well as extension and education. All research is competition based at the State level. Out-of-state scientists review proposals. About half of the pre-proposals are selected to provide full proposals for review. 5-10% of the research portion of the funding is directed towards aquatic animal health ($2-3M). State programs – half are research and about 10% are health related. National programs – either strategic plan or Congressional earmarks; for example: lobster mortality in Long Island Sound, Gulf of Mexico oyster industry program. Oyster disease program lowered from $2M to $1M in 2005.

Sea Grant State programs tend to have smaller projects around $75K, quick response programs at State level (eg. Lobster issue). At the National level there are also strategic and implementation plans. States should contribute to overall national plan.
National projects tend to be larger – multi State and multi institutional.

Overall at the State level there are about 500 individual projects funded per year. Sea Grant brings academic community into NOAA programs.

Small Business Innovation Research (SBIR) program and Advanced Technology Program at the Department of Commerce's National Institute for Science and Technology (NIST) are used to connect to industry. There has to be an industry partner. Example of an SBIR project – High Health Shrimp program, ATP has worked on vaccines and vaccine delivery.

NOAA's Aquaculture Matrix Team – Cross-office group within NOAA looking at marine aquaculture issues. Reconstituted in 2005 but started as early as 1997. Sea Grant is involved with JSA and through this arena worked with Interior and Agriculture to set priorities in animal health and research priorities.

International technical exchanges that include animal health issues are important in exchanging information and approaching issues.

Sea Grant looks at results from work groups, such as this one, to set priorities for funding. The ultimate outcome of research funding for FY2006 is unknown.

Regional NOAA/NMFS Science Centers located in Milford, Galveston, Oxford and Seattle conduct applied research in aquaculture and fish health work. Shrimp virus work, crustacean disease work (Frank Morado), mollusk disease work (Milford lab).
Budget process has constraints on availability of funding for research.

NOAA/NMFS operates the National Seafood Inspection Laboratory in Pascagoula, Mississippi conducts investigations on of variety of aquatic animal pathogens that have implications for human health, as well.

Janet Whaley (NOAA/NMFS) – Oceans and human health act. There is a new cooperative center for marine animal health program. The focus is to try to connect marine animal health to all the other species (fish, crustaceans, etc.). Find resources to respond to die-offs in the wild. Congress mandates NOAA's marine mammal response program. It encompasses wild marine mammal health issues. The program deals primarily with animals in the wild – everything to wild populations of marine mammals, stranding network, investigation of die-offs. Utilizes animals that are by-catch in fisheries, focused research projects monitoring wild caught animals, does health assessment and re-release evaluations. Can't cull or lethally sample marine mammals – so have to work on non-lethal health assessments! Response to marine mammal strandings is under NMFS jurisdiction. Stranding networks respond to stranded animals and collect data for NMFS. In rehab, NOAA mandated not to release animals that cannot survive in the wild or that pose a risk (for example, health). Tissue bank – from stranded and by-caught animals – these are being archived at the Hollings Marine Laboratory to do retrospective studies. Prescott Grant Program ($4M) that goes to the stranding network. Each group can get a max $200,000 a year.

Unusual mortality event program (mandated by Congress) – Die-off of marine mammals above and beyond normal stranding, can mount a response to investigate the event. There is a national contingency fund in place so the response network has resources to put towards the investigation of the die-off. A working group decides whether or not an incident is considered an unusual die-off. Also work with FWS with manatee issues. Expanding to look at other animals – sea turtles, fish kills, sea birds and to see how these may be related. Funds traditionally focused on marine mammals should be loosened to be able to address other issues (ecosystem management).

Fred Kern (NOAA) – Ocean and Human Health Act provides for funding for aquatic animal health issues as they related to human health – cryptosporidium, for example. Vibrio vulnificus work (clam and oyster aquaculture), girardia, etc. As long as it's tied to a human health impact, the funds can be used to address disease issues that are impacting the oyster industry. Ballast water and invasive species investigations also being funded – peripheral, but related to human health (*Vibrio cholera*, for example). Funding for NOAA Centers for Excellence and grant programs also available through the Ocean and Human Health Act.

Linkages to aquaculture – invasive and introduced species (*C. ariakensis* introduction proposed for Maryland, for example). *C. virginica* being looked at as a potential endangered species.

NMFS at one time had a large diagnostic program, but has been turned over to industry or universities. No national center for disease studies in one place.
Chapter 22 in U.S. Ocean Commissions plan deals with aquaculture.

Agriculture – Cooperative State Research, Education, and Extension Service(CSREES) and Agriculture Research Service (ARS)

Meryl Broussard – CSREES
There are many linkages between CSREES and State and university diagnostic labs. CSREES helps to set research priorities in aquatic animal health by responding to State and regional needs (through regional aquaculture centers) and at the national level. Critical issues funding allows funds to be released for emerging issues, for example, funds for spring viremia of carp (SVC) research.

Prioritization process for research is de-centralized. Competitive programs prioritization is more centralized.

CSREES works cooperatively with APHIS and ARS on research agenda. APHIS has traditionally worked with ARS to discuss research needs. CSREES will be entering into that process.

CSREES and APHIS support the NAHLN – National Animal Health Laboratory Network. As this develops, expands and strengthens, aquatics should be added.

Lew Smith – ARS

National program components are similar to JSA R&D strategic plan. Marketing and economics components not included as they are not a major focus of ARS. Technology transfer is an important component.

Cooperative Research and Development Agreement (CRADA) – CRADA used to make sure research is utilized (vaccine development, for example).
Patents are important to make sure that the product goes into production.
Several CRADAs in place to develop sustainable fish feeds (replacing fish meal).

ARS stakeholders tend to be major commodity groups (beef, swine, wheat) and try to narrow the topic to ensure something gets done.
Vaccine production is the focus in aquatic animal health research. Genetics is important focus in production systems research.

5) Interaction by Federal agencies and prioritization of aquatic health research.
Discussion took place on how the NAAHTF, the new JSA Task Force on Research and Technology, and the Federal research and funding agencies will interact and prioritize research:
Depends on resources, since, for example, some are no longer available at Sea Grant.
Final development and funding of projects occur if Congress agrees issue is important.
Executive process not working to get funds allocated unless emergency funds earmarked.
Agencies are trying to make do with strategic planning and partnerships. Project Planning Development and Evaluation System (PPDES) process used in NOAA. Always seems to be late in response rather than prevention due to limited funding. If funds don't increase, how do agencies decide what to fund? APHIS communicates with ARS to identify needs, and possibly address on top of what ARS is already doing, or goes

through CSREES for support. NOAA process does not seem to be as collaborative as APHIS' process.

NAAHP benefactors may want to link their needs with broader needs found within CSREES in order to obtain funding. Aquaculture can be linked to other broader initiatives such as genomics. Annually, the Office of Management and Budget (OMB) and Office of Science and Technology identify high research areas for the budget. JSA/NAAHP need a statement inserted in this budget document which shows importance in order to secure funding. Have to be opportunists to find new programs, etc. to keep aquaculture included – example – Interregional Research Project #4 - IR4 - for herbicides in aquaculture. Regional Centers for Aquaculture (RACs) in President's/USDA-CSREES' budget. This budget has tried to cut programs although Congress often puts it back in. Need to market and track program better to maintain programs we already have.

How we coordinate between agencies may depend on industries pushing Congress for a specific research need. Transparency is very important so industry can have input, interest, and buy-in. Industry has this relationship with CSREES as they are involved in selection committees, etc. Other departments need more industry input at the beginning for industry buy-in early on. Industry working with Congress and the States can have more impact. Projects need to be pertinent to a certain location or industry, for their specific needs.

Western RAC model is good example of industry working with government for selecting priorities for funding. Regulatory, applied, or basic research can be seen on broader picture, looking into the future. Research could be broader than one aquaculture industry, alone. Application can be much broader than one industry. This approach can be difficult to coordinate and may be idealistic. Opportunities to collaborate might be there but not funds to coordinate. Often can be better for administration not to coordinate, but on researcher level to coordinate with each other.

All Congressional line items performance review workshop helps to coordinate projects. At least this process gets researchers, agencies, and departments talking with each other. At a minimum, agencies become aware of, and use the network….it becomes the glue that brings people together. Small amount of funding can bring labs together from several resources, bring experts into the field to facilitate projects.

There is a need for an aquatic animal health working group of some type to become a formal group, like the WRAC model. Such a group possibly could be used to make recommendations, including industry. NSTC is too small, may not generate a lot of new resources but can point to what is of higher priority. Maximizing communication, coordination with stakeholders and Federal agencies could be "doable". Step 2, with stakeholder support, getting Congressional or Executive funding might not be doable. Budgets in Federal agencies are all downsizing with the exception of Homeland Security with food safety and security being an area for potential funding opportunities. There is a need for Federal agencies to share a vision to help optimize what they have now in

resources, planning, programs. Maximize what opportunities have aquaculture at the table in issues of overall agriculture such as the National Animal Health Laboratory Network (NAHLN). Maximize the use of resources as are provided for now, what resources can be provided for emergency issues. Big dollars and big programs are not likely in current funding environment.

We want to continue the programs we have; however, in a strategic planning process, we may need to reallocate funds as new money is not forthcoming. Competitive grants work similarly as priorities change in grant programs. We need to look at how funds could be better used now.

6) Priority research list from WG – 11, Research Forum

We need to develop and use existing tools to further enhance communications between agencies, industry, and stakeholders. Need exists to formalize the process. If we develop a list of priorities for future research, how do we do it? One approach - link issues across species, and increase support.

A broader research plan needs to include stakeholder meetings, input, etc. We may want to hold these discussions after industry input to this meeting of WG 11.

With aquaculture seen as but one, small commodity within many, what agriculture item has captured the interest of the press? It is BSE and there has been only one case in the US. Whether scientific or not, it is perception or a sensational issue that often gets the attention. Are there any emerging diseases in fish? Possibly there is with SVCV. Lay people don't read newsletters, scientific journals. Media connections, communications can make more of a difference than the science involved.

Disease is one of several limiting factors in the production of all commodities. The aquatic health community has been unable to secure attention and sustainable funding for research. In shellfish, diseases in the wild get more attention than in production. Over recent years, there has been less federal support of aquaculture, overall. For example, Whirling Disease has had significant funding, but is not one of top 3 diseases in production of trout.

Science is moving forward overall in big picture (genomics, etc.). How does it impact global competitiveness? Are we moving in the right direction?

Can the JSA serve as coordinator for funding of aquaculture research projects? There is a need for a structure/group to look at projects, prioritize. This possibly could be done through JSA. Federal Advisory Committee Act (FACA) could be an issue, but meetings can be organized to listen to stakeholder input. While JSA is a coordinating structure, implementation happens at the agencies themselves. JSA provides linkages to programs. Leadership is spread thin on agency level as well. It takes time and resources to bring agencies and stakeholders together. JSA is as effective as Federal agencies want them to be. It needs to be more than just a discussion group.

NAAHP needs to suggest a system by which research efforts are documented. Need a database of who is involved, scientists, what they are doing. Current research information system (CRIS) includes ARS and CSREES funded research only and is not used across agencies. Is there an opportunity to enhance collaboration? If expertise is required and not found in a specific unit, there is a need to find the expertise or work collaboratively with someone who does have the expertise. CRIS is often used as issues arise, to search what research is currently being performed, for media, etc.

Documentation of where the aquatic animal health researchers are located may or may not lead to new increases from Congress through stakeholder support. Barley group for example is very small, but very efficient at lobbying Congress for support.

Finding data from Sea Grant program is much more difficult. No national listing of all the programs, but all divided by State. One would have to search each State to get a picture of what's being done nationally. We need links to show what researchers are doing what work.

Research needs for program diseases of finfish:

ISA and SVC are currently APHIS "program" diseases. Industry is often more interested in diseases we do not know about, i.e. emerging diseases, than ones we do know about.

EU aquatic animal immunology example may be helpful for similar groups in U.S. Big, multi-institutional, high dollar projects with one administrator in EU currently.

Science vs. political rationale for depopulation. The impact on industry and on wild populations must be considered prior to de-population. Although it is at the Federal level where national needs for disease prevention are identified, it is difficult for agencies to attain funding when funds are given out reactively rather than proactively.

List of mollusk diseases and pathogens from website provided by Fred Kern. There is very useful information on these diseases (see report from WG 7, mollusk diseases). Early findings in wild populations of *Perkinsus marinus* are culturable and transferable in the laboratory while MSX is not easily culturable. The need exists for surveillance programs, importation and transfer regulations, detection. Basic research still needed for many of the shellfish diseases. Need exists for management strategies after diseases are found in production facilities and the wild, including epidemiological studies. There are limited diagnostic and management tools. Regulations restricting importation from other countries are very important for prevention of exotic diseases. Development of resistant strains, genetics is another area of need.

END DAY ONE

October 14, 2005

Recap of day one discussions.

Cooperation and coordination is needed between agencies via JSA. The reality of budgets and politics greatly affect research dollars and priorities. Research issues brought up yesterday by Scott LaPatra, Andy Goodwin and Fred Kern. Today's goal is to hear about crustacean research needs and then summarize discussions and look at suggestions the NAAHTF can put forward in the plan as suggestions for how to prioritize aquatic animal health research, such as the CRIS database and other ideas, like the RAC model.

Would one of the goals be to have a linkage between programs for all species/diseases within aquaculture? Is there a single source of information on diseases/pathogens and researchers working on them? CAB International (CABI), a publishing company, is developing an international aquaculture database. There is a fee to have access to the information and several agencies are "partners" in the project.

Industry is interested in a listing of researchers and scientists and what topics they are specialists within. AVMA is working on a database of veterinarians with expertise in aquatics and labs that do aquatic disease work. The International Association of Aquatic Animal Medicine (IAAAM) put out a questionnaire to allied fish health professionals working in aquatics asking about their specialty.

A high priority request from industry in this research working group would probably be to have a listing of the aquatic animal health experts, laboratories working in aquatics and a listing of all aquaculture related research and who is working on the projects.

Expand the CRIS concept to encompass all research related to aquatics.
This is what the JSA is all about – enhancing coordination between agencies.

Sea Grant has a list of science experts – can be found on-line. There is also a listing of Sea Grant projects – this could easily be linked to from other web sites. Database systems on the national sea grant web site. 90-2 is a project summary for every project, there is also an accomplishment section.

Annual reports for CSREES show similar information. This is stored in the CRIS system. There is an aquaculture sub-file that can be searched.

It all comes down to communication, coordination and streamlining the information.

Keep in mind not all researchers will want to include detailed information on projects they are currently working on, as they will want to protect the information until it's been published.

There could be proprietary issues as well – however, we're not really looking for that kind of detail – we're looking for researchers and their general topics of research interest and overall project objectives.

Jeff Lotz - Crustaceans (restricted to shrimp aquaculture):

6 points (general areas):
-Epidemiology and identification of risk factors (how to predict fitness of sites, how environmental factors affect the suitability of a site)
-Identification of reservoir hosts and sources of infection (where the pathogens are coming from that are causing the problems)
- Breeding genetics, not just for breeding new characteristics but quantitative genetics – inheritance; for example how disease resistance genes are inherited and identifying those genes. This can only be met by having a large-scale breeding and gene mapping program (genomics, functional and structural, in general). This requires a large and long-term program. Good progress is being made in disease resistance – particularly for Taura, using selective breeding. The original stock was very susceptible to Taura, but through breeding you can have up to 95% resistance. The perception is that the animals selectively bred for growth are not as resistant to Taura. Selective breeding for White Spot has not been successful. For Taura resistance, the heritability is not good. This suggests there may be a large number of genes involved. Mapping *P. vannemei* is in progress. Oyster genetics are also being carried out in the bay. Survival has been increased, but it's still not high enough (an increase from 5-6% to 30% survival). Also, when you're breeding for resistance to one pathogen, there is no guarantee there is crossover resistance to other pathogens and there is always a trade-off (for example, in growth). You can also see the development of new strains of virus, and resistant shrimp may no longer be as resistant when faced with a new strain.
- Innate immunity. The adaptive immune system is usually associated with vertebrates, but the innate immune system has much in common with vertebrates and possibility of studying crustacean immune system, possibly in conjunction with other vertebrate immunologists.
- Looking for epitopes and pathogenesis factors of pathogens. Differences in pathogens or tissues in chronic vs. acute infections. The evolution of pathogens within the host. Dynamics of pathogens inside the host.
- Evolution of pathogens. For example, RNA viruses lack proof-reading mechanism and therefore have high mutation rates. The result is that these viruses change rapidly. Strains of virulence in Taura are seen in different locations, probably due to rapid mutation. New, emerging viruses are just as likely to be new strains of existing viruses.
- Diagnostic improvement has taken place. Now we need to do more refining to be able to determine what strains are bad and what ones are less virulent that you can live with – taxonomy of the viruses. Go beyond presence of pathogen to determine if you have a harmful strain or one that's less harmful.

Yellowhead virus in Australia is called gill-associated virus – they are the same pathogen, but some molecular differences. Australia's regulatory approach to the virus depends on the strain they're dealing with.

If you have a different name for the pathogen, regulatory consequences can be different. This is an important consideration for regulatory purposes.

How pathogens are distributed between labs doing research on them – agencies that are listed and have certain lab requirements – select agents, etc. National Environmental Policy Act (NEPA) requirements have to be met to work with these agents if it's a Federally funded project. If the funding is not Federal, NEPA is not considered, even though the ramifications would be the same.

We could coordinate with funding agencies to educate researchers about NEPA and select agent requirements. Whether or not NEPA has to be followed, we should try to coordinate so that the requirements are the same regardless of who is funding the research.

There should be guidance, if not, more rigorous requirements regarding movement of pathogens, reagents, etc. even though scientists consider it their "right" to exchange and bring exotic or dangerous pathogens into their labs.

There is a need for a suite of assays designed to address risk appropriately rather than speculating – examples include food safety issues and movement of pathogens through products.

Emerging, re-emerging and surging pathogens – how do we address these? We've had successes in addressing these issues. The shrimp virus task force is an example. With our networks we can bring the appropriate players and experts together to address the issue. When it comes to funding and the recommendations from the NAAHP, the funding agencies will continue to fund on broad-based R&D strategic plans. However, for these emerging, re-emerging and surging pathogens, we can react more quickly through our networks coordinated through the JSA.

There are multiple ways the NAAHTF can communicate to the other Agencies and implement programs with the assistance of the other Federal agencies and partners, stakeholders.

We need to put something in the plan about funding to help bring the science and regulatory people together and provide the funds to do so – contingency planning. This has been previously identified as one of the components of the NAAHP.

Risk assessment and epidemiology are two recurring themes throughout this workshop as it pertains to science and gaps of regulatory research needed for the NAAHP.

8) Next steps – Suggestions and recommendations for input and action items:

Broussard - Things that can be done and would be important to do in regards to research agencies and how to respond, and what's needed by the regulatory agencies and what the role of the NAAHTF would be:

- Develop a process for how the NAAHTF will deliver its research needs to the funding agencies, recognizing the regulatory agencies will confer with stakeholders
- Identify rapid response issues
- Identify more long term research needs
- Communicating officially what the needs are from the NAAHTF
- Prioritizing short term and long term research needs
- Research agencies need the opportunity to feed back to the NAAHTF

Since industry and stakeholders outside of Federal agencies can't officially be members of task forces, industry would like to see a separate committee within the NAAHP (a FACA committee) that could provide input on the research needs.

Although membership on task forces is for Federal employees only, there are multiple avenues (besides developing a FACA committee) that allow for input into the plan and task force activities.

Go beyond the APHIS meetings with CSREES and expand to the task force providing recommendations on behalf of multiple agencies and stakeholders regarding research needs.

Should emergencies arise, as was seen with the shrimp viruses, the issues would be addressed via the NAAHTF and the same type of coordination (regulatory action, science, risk assessments, etc.) would be addressed via the NAAHTF.

Build into the plan how these types of actions would be implemented via the NAAHTF and the NAAHP. The funding agencies will let us know how they can or cannot help to bring in the science, research and experts.

Maybe industry should develop some priorities through the NAA to send via the NAAHTF to JSA and the Federal funding agencies.

Similar to CSREES, ARS meets with APHIS yearly. Rather than presenting APHIS priorities, we can present NAAHP and industry priorities to ARS (recognizing that ARS holds stakeholder workshops). ARS is on 5-year cycles, so they may not be able to react to research needs immediately. However, the NAAHP can still provide guidance for future needs and projects related to the NAAHP. Improving the responsiveness to research questions would be helpful too. Much of what has been discussed in this workshop would fit under projects currently underway at ARS. For example, APHIS identified SVC as a priority while ARS was developing its 5-year plan.

Sea Grant operates more at the local level than at the national level. There is only one person at the national level. The Sea Grant response would be to connect to the State network to see how those program funds could be used to meet our needs. This is the current paradigm. Is there a better way? Participate in holding workshops to identify at the national level (with partners) the types of actions that would be appropriate for the

current situation. Working through these types of workshops and bringing resources to the table.

What about NMFS and NOS labs? Could there be more of a collaborative process where strategically the labs deal with the issues rather than keeping it local? Depending on how broad the issue is, workshops can be put together to bring a national group together to see how they could respond. Sea Grant brings research together for larger national issues and then the States are funded to do smaller projects as they arise.

Centers for Excellence (OER, NMFS, NOS) – Federal center for marine or aquatic diseases? This exists somewhat in the marine mammal health program.

Within the laboratory system, experts can be identified and brought together.

Sea Grant is not a programmatic office – the goal is to train the students and professors who will be conducting the research.

The intent in NOAA is that the Aquaculture Matrix staff, which includes an aquatic animal health coordinator position, would deal with coordinating aquatic health research as it applies to marine aquaculture. However, much work is to be done to enhance communication and agency-wide collaboration on the issues. Now typically, this coordination at the State level involves Sea Grant.

Getting people together to address the long-term issues - How could NOAA work together from a national perspective and pull things together that are currently not well-defined? The capacity exists but how to coordinate is evolving (NOAA).

One of the recommendations would be to define how to coordinate beyond the NAAHTF (within agencies not only between).

There's a lot of expertise that's not only in Federal agencies – and that expertise should also be brought into the "system".

Some of the education aspects would fit into this process as well.

Industry needs to communicate its needs and push through to the task force.

Often you can't prove a process is essential (like bio-security) until an event occurs that shows how it's important (disease outbreak).

If an Agency has a research agenda that is different than the industry research agenda, industry wants the opportunity to be at the table to have a vote and have their voice heard.

One of the dominating concerns in the mollusk work group was the OIE and our interactions with them. How does the US interact with the OIE?

US has improved responses to OIE proposed changes. We pay attention to the OIE but don't necessarily adopt all their guidelines. Is Asia involved? We need to investigate if China or other Asian countries are members. Many are not members.

Key points by Steve Smith:

- CSREES would welcome input from the task force on research priorities.
- Establishing and continuing the communication process for research needs would be useful.
- Transparency of research projects – could we organize a list of URLs or someway to make it easier for a person to find research being funded by different Agencies?

Evaluation forms distributed.

END OF WORKSHOP

Feedback from evaluations:

- Six participants completed evaluation forms.
- All strongly agreed or agreed that the workshop was well organized, objectives of the workshop were met, facilitators worked effectively, sufficient time was provided for the workshop, and a diversity of interests were represented, with the exception of one individual who thought a more diverse industry representation would have been beneficial.
- Additional written comments: Good use of PPT projector to display minutes during progress of meeting; information from govt. agencies on research process and funding was very informative; concern expressed that more industry diversity needed; one individual enjoyed the workshop and appreciated the efforts of the Task Force to bring this issue forward.

Research Needs for Program Diseases

Andy Goodwin

In choosing my perspective for this talk, I have considered my various roles as a professor that does fish disease research, as an Extension specialist often called upon to serve as an advocate for the aquaculture industry, as a fish disease diagnostician, and as the vice president of the AFS-FHS. The research priorities that I have chosen to highlight are a result of those various perspectives and of my work with aquaculture including the catfish, baitfish, and ornamental fish industries. Rather than deal with details of particular diseases (except SVCV), I have chosen to take a broad perspective.

1. Fish producers are more afraid of the diseases that they do not know about than they are of the diseases they know. Thus, for them it is important to identify potential PAADs before they cause fish losses in the US. This requires studies that directly address host range, routes of transmission, and efficient diagnostic tests for emerging pathogens. In the ornamental fish industry, the story of KHV is an example of what can go wrong when an emerging disease is not addressed quickly. The first cases of KHV occurred in the mid 1990s in a fairly limited geographic area. The viral nature of the disease, its ease of spread, and high mortality were all recognized quite quickly. In subsequent years, the disease has spread devastating foodfish industries in many countries and huge losses on the koi industry. International politics and concerns over diagnostic assays have led to an almost 10 year delay between those first cases and any serious consideration of putting the pathogen on the OIE list. Ironically, the current debate about listing KHV centers around whether or not it is so widespread that control efforts aren't justified.

Producers in the catfish industry are concerned about several catfish viruses reported in Europe. They would like to know, before the viruses appear in the US, if these are serious pathogens of cultured channel catfish.

It is vital that we do the research to quickly recognize emerging pathogens act to limit their spread. If we wait until the disease is widespread and devastating, it is generally too late to do anything about it.

2. While the whole broad area of risk assessment is vitally important in commerce, specific aspects are probably more worthy of immediate attention We need to know much more about the current ranges of fish pathogens in the US. Decisions to disallow interstate and international fish movements are often based on incorrect assumptions about the absence of a pathogen in a particular region. For example, I have been assisting an out of state producer in his efforts to ship smallmouth bass to another state. During my inspection of the bass I found largemouth bass tapeworms. Based on that finding, the recipient state prohibited the shipment on the grounds that the fish contained an exotic pathogen. Conversations with other biologists have made it clear that the bass tapeworm is already common and widespread in that state, but in the absence of published information documenting that distribution, the farmer has been unable to win approval for the shipment. The National Wild Fish Health Survey would be able to provide the

vital information upon which rational decisions could be made, but that program is not well funded and there has not been sufficient progress to make the NWFHS a useful tool for most regulatory decisions.

We also need to know much more about the host ranges of RAADs and PAADs. Much of the US concern about SVCV has centered on the potential of that pathogen to affect populations of wild fish. Unfortunately, the previous geographic range of the disease has only provided host susceptibility information for fish species common in Europe. It seems likely that US cyprinids, and perhaps several other fish families, may be hosts for the virus, but there is insufficient data available to make rational decisions. A large interagency group designed the needed studies and there was great hope that the USGS would be able to conduct it, but sufficient funding has not been forthcoming. How can we make rational decisions about the control of SVCV when we don't have any way to estimate the potential impacts on wild fish?

3. We need better ways to deal with the fish health certification aspects of viral latency. Many fish pathogens exist in latent forms that are very difficult to detect (examples: the herpesviruses CCV, OMV, and KHV). We need better strategies to detect infected populations and more careful assessments of the risks posed by fish shown to carry latent infections. There have been arguments (correctly I believe) that putting KHV on the OIE list is not appropriate because we lack assays sufficiently sensitive to detect carrier fish, however, other herpesviruses (CCV and OMV) associated with similar detection challenges have long been OIE listed. Interestingly, CCV and OMV have recently been dropped from the OIE list. We need to develop a strategy of sensitive diagnostic tests and surveillance programs to detect and deal with latent infections and must determine which latent infections are actually a risk to naïve fish.

4. Field vaccine efficacy data: If vaccines are to be a part of any National Program, we are going to need to know much more about the efficacy of vaccines in the field. While many excellent laboratory studies have been done, the field efficacy of vaccines labeled for many important aquaculture diseases is unproven. In order to include these vaccines in Extension recommendations to farmers, Extension specialists must have access to convincing field data. While I do appreciate the difficulties inherent in field studies, and the patent protection issues involved in the sharing of vaccine data, these efficacy issues are critical.

5. SVCV, a current program disease: In order to conduct a truly efficient SVCV program in the US, we need answers to several important questions. I have already mentioned then importance of studying species susceptibility to SVCV. The other big problem is detecting infected populations during the time of year when active infections do not occur (summer). Testing in July of thousands of fish from populations demonstrated in early spring to carry SVCV yielded not even one positive culture. Where is SVCV in the summer? Is it present at low levels in a very low number of fish (prevalence so low that infected fish are very unlikely to be sampled) or does it subsist in some other host? It is

even possible that the virus does not persist through the summer in fish cultured in areas with very warm climates.

There are other concerns about the difficulty of finding SVCV in the summer. Most fish tested as part of wild fish surveys are collected during the summer. The only way to detect populations of wild fish exposed to SVCV is to look for anti-SVCV antibodies in fish blood. There is a published ELISA assay that works for this purpose, but several agencies have been unable to convince rabbits to produce antibodies with the appropriate characteristics. The Great Lakes Fisheries Commission is now considering a proposal that will fund development of a new assay. The ARS has already assisted this effort by producing a polyclonal ant-carp Ig antibody. Hundreds of serum samples from wild fish have already been collected by state and federal agencies.

There have been concerns voiced about diagnostic assays for SVCV. Fortunately, the virus grows very well in culture and is easily identified by PCR assays. Current OIE protocols require the sequencing of the PCR product and confirmation by sequence based phylogenetic analysis, however, assays specific for SVCV, and even for Asian strains of SVCV, have now been developed.

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1) Development of easy to deliver, efficacious vaccines.
    - Chemotherpeutants available to assist in fish health management are very limited. Consumer and environmental concerns regarding the use of chemicals and antibiotics also support that this is not an optimal fish health management strategy. Killed, live-modified and/or recombinant vaccines that are safe, potent and easy to deliver are required for effective fish health management.

2) Development of cost-effective mass immunization strategies.
    - Many effective vaccines for fish exist, however, a number of them require injection vaccination to achieve significant efficacy. For many species of fish injection vaccination is not feasible. Alternative vaccine delivery strategies for mass immunization of fish are needed.

3) Determine environmental fate of fish pathogens using standardized in-vitro assays.
    - The literature is either non-existent or inconsistent regarding the effect of temperature, pH, freezing, drying, etc. on certain fish pathogens. Additionally, survivability in different aquatic environments under different conditions needs to be assessed along with the effectiveness of available disinfectants. Standardized testing procedures need to be developed and specific fish pathogens tested systematically.

4) Develop accurate risk assessment techniques (e.g. modified Delphi Technique).
    - Risk assessment is used very effectively in many other domesticated animal industries. Aquaculture is a relatively young form of agriculture and accurate epidemiological information is lacking in many cases. This information should be developed along with identifying on-the-farm risk factors for minimization of disease introductions and impacts.

5) Better fish health through nutrition.
    - Identification of dietary ingredients and/or immunostimulants that can enhance fish health cost-effectively would be a powerful management strategy. As additional information is acquired regarding the innate and adaptive immune responses feed formulations should be examined with the goal of enhancing immune responses. However, functional immunological assays need to be developed in order to accomplish this goal.