Workshop Overview and Rationale

Marine aquaculture has emerged as an industry that is growing at an unprecedented rate and occupying an increasing space along our nation's coastline. The offshore waters of the southwest U.S. have extraordinary potential for development of a marine aquaculture industry that is economically and environmentally sustainable and socially responsible. In fact, the Southern California Bight could support development of an offshore aquaculture industry that could become a $1 billion/year industry given the region's suitable environmental conditions and access to local and global markets for distribution of seafood products.

We convened a regional workshop to support marine aquaculture planning in coastal communities, identify and address current or potential development conflicts, inform and support public outreach and education efforts, and increase awareness of the environmental, economic, and social benefits associated with marine aquaculture.

Workshop Goal

The goal of the workshop was to develop the frames of reference and rationale for creation of an offshore finfish aquaculture industry in the Southern California Bight. Offshore aquaculture development has been a subject of intense debate in coastal communities around the nation. Large barriers to starting new offshore aquaculture ventures are public perception and regulatory concern that industry development will have significant environmental impact. A critical element needed by coastal managers and local stakeholders is awareness and confidence to use science-based decision tools to inform coastal ocean use plans and equitably resolve points of resistance to industry development.

Stakeholder Engagement
Participants included local, state, regional, and federal coastal managers, scientists, engineers, aquaculture entrepreneurs and practitioners with proven expertise in the field of aquaculture and environmental science. Workshop attendees were asked to actively participate in a decision-making process to share and prioritize concerns regarding complex, high-stakes environmental and resource issues. A professional facilitator guided conversations where tough policy questions combined with lively politics and contested facts.

Proceedings
Proceedings will be made publicly available to empower coastal managers to create new options and initiatives for aquaculture production, resolve conflicts with ocean use, and improve decision-making regarding siting and regulation of aquaculture in the Southern California Bight.

Minutes prepared by Annalisa Batanides, Jonathan MacKay and Rachel Fuhrman

---

SUMMARY OF ACTION ITEMS FROM WORKSHOP:

- Group will be provided all presentations given by those who are willing to share their presentations with the group
  - Let Linda know if not comfortable with sending out PDF's of presentations. Will be made available to group
- Let Linda know if issues sending out contact information to group
- *Carol & James:* Will distribute Marine Cage Culture and the Environment publication
- *Randy Lovell will distribute* information for Aquaculture Matters website (http://aquaculturematters.ca.gov/)
- *Corey Peet*, Monterey Bay Aquarium, will share publications on the Seafood Watch Program and how they do recommendations, aquaculture criteria, and link to fisheries.
- Link environmental topics with agencies' roles (offshore permitting process in California)
- Rose Canyon Interagency Working Group (RCIWG):
  - *Diane* will set up next meeting/call and start the conversations based on consensus items
  - Interested in soliciting feedback from this group on whether the next RCIWG meeting should wait for the meeting summary (from this meeting) or not
  - If interested in participating, let Diane know (goes to discussing optimal membership)
- *Possible action item*: get official endorsement and charter/ evolve to formal status
- *Proposed action item:* try to create communication information sharing mechanism so all relevant parties have information they need. (Seems like we have lots of centralized databases, and hard for entities to know where to get information)

MEETING MINUTES

Attendees:

Kevin Amos (National Oceanic and Atmospheric Administration [NOAA])	John Bannon (United States Coast Guard [USCG])	Annalisa Batanides (Sea Grant Fellow NOAA Aquaculture)	David Caron (University of Southern California [USC])
Alan Cook (Icicle Seafoods)	Tom Dempsey (Nature Conservancy)	Mark Drawbridge (Hubbs-SeaWorld Research Institute [HSWRI]) (HSWRI)	Alan Everson (NOAA)
Steve Gaines (University of California Santa Barbara)	Scott Hamilton (Moss Landing Marine Laboratories [MSML])	Jevon James (USCG)	Krista Kamer (California State University [CSU])
Don Kent (HSWRI)	Dale Kiefer (USC)	Logan Kock (Santa Monica Seafoods)	Letise LaFeir (Monterey Bay Aquarium)
Randy Lovell (Aquaculture Coordinator, California Department of Fish and Wildlife [CDFW])	Sonke Mastrup (CDFW)	Jonathan MacKay (Sea Grant Fellow CDFW Aquaculture)	Chris Mobley (NOAA)
James Morris (National Ocean Service [NOS] Coastal Aquaculture Planning and Environmental Sustainability Program [CAPES]-NOAA)	Paul Olin (California Sea Grant)	Corey Peet (Monterey Bay Aquarium)	Carol Price (NOS CAPES-NOAA)
Amy Rens (USCG)	Jack Rensel (System Science Applications)	Kenneth Riley (NOS CAPES- NOAA)	Bonnie Rogers (USACE)
Mike Rust (NOAA)	Penny Ruvelas (NOAA)	Jerry Schubel (Aquarium of the Pacific)	Dan Swenson (USACE)
Paula Sylvia (NOAA)	Kim Thompson (Aquarium of the Pacific)	Melanie Tymes (United States Army Corps of Engineers [USACE])	Michael Van Houten (USCG)
Russ Vetter (NOAA)	Steve Weisberg (Southern California Coastal Water Research Project [SCCWRP])	Walt Wilson (Navy)	Francisco “Cisco” Werner (NOAA)
Diane Windham (NOAA)			
Rich Wilson (Seatone Consulting): FACILITATOR			

28-April Tuesday

8:30 WORKSHOP REGISTRATION AND HOSPITALITY BREAKFAST

9:00 WELCOME AND WORKSHOP CHARGE

Jerry Schubel, Aquarium of the Pacific

Thank you to Molina Healthcare, CA Sea Grant, Steering committee, Linda Brown, facilitator Rich Wilson

Focus: Offshore Finfish Aquaculture Science

- Assess adequacy of science to site and operate offshore finfish aquaculture operation, with minimum risks to environment and marine life.
- Adequacy through 2 lenses: scientists and regulators/policy-makers
- Develop regulatory pathway for sustainable offshore development

James Morris, NOAA National Ocean Service

Coastal Aquaculture Planning & Development Program:

National Ocean Service (NOS) is building a program to focus on coastal aquaculture planning & development. Focus is *how* to move forward sustainably and navigate the permitting process.

End goals:

- Learn new things,
- Better understand neighboring agency's mandate/role/responsibility,
- Form *group consensus* on next steps following workshop discussions

Relationships:

Decisions are made socially. Part of this process is getting to know each other and *build relationships* so decision-makers can later use these relationships in making decisions

Regulatory confidence:

- What IS regulatory confidence:
  - Confidence that regulatory process is adequate.
  - Confidence that others are doing their job well.
  - Wide variety of tools available to make decisions.
- It is NOT:
  - Playing devil's advocate forever.
  - We know that the risk is not appropriately paired with the concern, and at some point we have to have enough confidence to make a decision.
  - Where risks are viewed as overly complex, long permitting times

At onset, start from place of collegiality and encourage interaction

Ground Rules:
Use common conversational courtesy

Stay focused on the workshop agenda

Share the air

Take a problem solving approach to find agreements

Be comfortable

ISSUES
1. Net pens
   - Certification programs plans info public perception
2. How to identify public perceptions (companion to science process)
   - Aquarium developing courses
   - Need good science then work on public perception
   - Translate science for public understanding
3. Public perception influences regulatory decision-making
4. Need to make compelling argument for need for aquaculture; build arguments to get past negatives
5. Need to think about who consumers are/audience
6. Explore/ understand decision-maker concerns

Rich Wilson—Facilitator

His job: to help group have an effective meeting, ensure inclusive discussion and identify consensus agreements that guide next steps.

Quick introductions around room

Summary of agenda:
Day 1: Largely information sharing and exploration of what people see as environmental concerns
- Rationale of aquaculture industry
- Concerns with industry
- Presentations of themes: state of the science, industry needs, available data, current ocean uses
- "Lightning talks" (5 minute presentations for anyone to share information)
- Evening dinner

Day 2: Explore regulatory framework and science needs to support decision-making; end with decision-making exercise

915: RATIONALE FOR AQUACULTURE AND CURRENT STATUS OF THE SOUTHWEST REGION MARINE AQUACULTURE INDUSTRY
Presenter: *Paul Olin, California Sea Grant*
Offshore AQ in the Southern CA Bight: Rationale, Current Status, challenges and opportunities

Objective: set *foundation* and *context* for the rest of this workshop.

Groundwork:
- CA state legislature decided aquaculture should be encouraged
- CA Pub Res Code 826-828
- Kathryn Sullivan at NOAA
- 2015 dietary guidelines

Why Aquaculture:
- World fisheries plateau with increased population/consumption,
- US trade deficit,
- Fish/seafood as healthy food source,
- Efficient feed conversion ratio,
- Efficient edible yield,
- Food security

Why not Aquaculture?

- Concerns:
  - Escapes, predation/competition/disease, altered genetic variability, therapeutants, pollution, fish meal issues
- Some offered responses to concerns expressed:
  - Escapes: minimal,
  - Fish meal: not harvesting large amounts of forage fish anymore but using byproducts/alternate feed,
  - Antibiotics: industry vaccines replacing use of antibiotics to large degree

Precautionary principle: Two interpretations

1. Strictly regulate aquaculture/restrict development
2. Encourage aquaculture while strictly monitoring concerns/potential impacts, to minimize and address potential issues (*goal* to move toward this view)

Recirculating aquaculture production systems:

- Study done showed that majority are not economically feasible, although a couple types are profitable
- Won't produce volume of fish needed for domestic demand

New offshore technologies

- New netting material (minimize escapes / prevent predation)
- New cultured species:
  - Yellowtail, Hawaiian Moi, Cobia, Atlantic Cod, Kahala
  - Promising: Sablefish, Pompano, Red Porgy, Red Drum, Bluefin tuna

Problems will always arise, so research is crucial to meet issues

<u>Questions/comments:</u>

- ***ACTION ITEM:* Group will be provided all presentations given by those who are willing to share their presentations with the group**
- Kevin Amos: more discussion about risk and risk analysis
- Kirsta Kamer: Environmental impact of closed recirculating systems vs. net-pens (listing on Monterey Bay Aquarium—marine cage production is listed "yellow" and closed systems are listed "green")
  - Response: we can raise fish in net-pen with acceptable environmental footprint. Also, there is an ethical problem with importing fish from overseas if not environmentally sustainable; fish should be produced locally.
    ***Point of disagreement:* environmental impacts of net-pen operations**
- Randy Lovell: would like to revisit issues that bear more discussion
  - Rich will document "issues" list, first one being net-pen *(See above)*
  - Call to all participants: keep in mind all issues that must be addressed and next steps to

take

- Sonke Mastrup: *Public perception* component—science of "human dimensions." Must be addressed
  - Response (Rich): look to planning team, and add this to "what are your concerns" exercise

    ***Point of consensus:* Perception issue is huge challenge to overcome to establish aquaculture in the Southern California Bight (SCB).**
    - Jerry Schubel: Has developed outreach programs and courses on the issue of public perception. Needs: good scientific documentation out of this meeting, then he can work with people who know how to change public perception.
    - Diane Windham: Goal of policy makers is taking science and translating to the public. First, need to build foundation for education and outreach.
    - Paul Olin: To change public perception, must start with strong foundation of science and current techniques.
    - Ken Riley: seafood certification programs (*flag for future conversation)*
- Russ Vetter: conversation shouldn't be just "consequences of AQ," but "consequences of aquaculture *versus other means of seafood production*," so we can make real informed decision (for example, incidental catch in wild fisheries is unavoidable; bycatch has a greater impact than aquaculture)

Diane Windham, NOAA National Marine Fisheries Service

Status of AQ from a federal perspective

Context for NOAA's role relative to aquaculture

- Aquaculture is longstanding priority in NOAA since 1980's: expanding aquaculture while maintaining healthy marine ecosystems
- In California: expanding aquaculture into federal waters
- NOAA has clear role and expertise, but no legislative authority to permit aquaculture in federal waters off California
- Opportunity now to develop a framework; Rose Canyon Fishery is test case

Randy Lovell, California Department of Fish and Wildlife

The predictive modeling efforts and the workshop discussions we're embarking on with this project represent very important tools to help inform the creation of a much-needed regulatory framework for offshore finfish aquaculture in California. However, the tools being refined within this project only have use if they are trusted: through vetting by frank discussion and by taking model predictions into the field to see how close they are to real operations. Our measure of success in this project will be the confidence gained in these predictive tools and the willingness of public resource trustees to go ahead and approve projects for trial.

Helpful sources of information:

- Publication by Carol Price and James Morris: Marine Cage Culture and the Environment (really useful for PEIR analysis currently underway)
- *Aquaculturematters.ca.gov*—outreach and education

***ACTION ITEM: (Carol & James):* Will distribute Marine Cage Culture and the Environment publication**

Questions:

- What is the time frame for Programmatic Environmental Impact Report (PEIR)?
  - "Almost there" (can't give specifics)
- Steve Weisburg: We need to pull "the need for aquaculture" out of this session, which we haven't done. If we want to move forward, we need to establish the need: we get a better product or fresher product, cost is less, etc. Need to build these positive arguments to get past the negatives
- Krista Kamer: who is the mass audience? Upper income/ lower income/ socio-economic
  - Response: Alan Cook: Public perception, not addressing mass market. Mass market already convinced aquaculture products are good (6-9% growth per year). The "market" is politically active population (small); need to think strategically about message and who we are reaching
  - Many markets for farmed fish (e.g., Costco, not just upscale Whole Foods)

10:00 STAKEHOLDER ENGAGEMENT ACTIVITY: KEY ISSUES WITH OFFSHORE AQUACULTURE

Facilitators: *Rich Wilson and Paul Olin*

See attached handout: "Rank Your Concerns"

What are your environmental concerns? As a regulator how will you address those concerns? Do you have adequate tools or resources to regulate or make a decision? The facilitator noted that results of this exercise would be non-attributable and not commit anyone or any agency to a particular course of action. Exercise results would simply be used to focus discussion over the course of the workshop.

1. Siting - Ocean Use and Aesthetic Impacts
2. Nutrient Enrichment - Water Quality and Benthic Impacts
3. Protected Species
4. Chemicals (heavy metals)
5. Drugs and therapeutants
6. Feeds (feed conversion and growth efficiency)
7. Feeds (fishmeal)
8. Escapes (offspring and adults)
9. Disease
10. Invasive Species / Non-Native Species
11. Biodiversity / Ecology
12. Genetic risk
13. Other issues

[A multi-voting exercise was conducted to inform discussion for the rest workshop. Each individual participant flagged issues as he/she saw them, then worked through the science/perception issues during the rest of the workshop.]

Process:

- Each person individually filled out handout, ranking environmental concerns about aquaculture (5 votes to identify priorities, one of which is top priority)
- **Mark top priority with "black dot"** and other **priorities with "yellow dots"**
- Identify areas where you have scientific concern/ inform science and planning

Questions/clarifications on the exercise:

- Mark highest concerns on behalf of constituency you represent (not personal belief)
- "Concerns" may be based on environmental impact/ negative context, or some other reason
  - Response: Use this exercise to identify where you have scientific concern, to inform science and planning
- Suggestion: that this exercise be limited to regulators
  - Response (James & Ken): this is preliminary exercise, and everyone's opinion matters. At end of workshop will compare participant opinion/concerns
  - Response (Rich): basic idea of this is to focus discussion. If you have different perspectives of what a "concern" is, go with instinct

Point of Disagreement/Concern: these "concerns" are all expressed in the negative, so some don't feel comfortable voting. Abstaining from voting in this exercise.

  - Response: Fine to abstain, because vote is counted as "no concern"
  - Can also look at this as issues that need to be addressed, rather than "concern" in the negative. In basic sense this is an issues assessment

***Consensus: CHANGE IN TERMINOLOGY*:**

  - Expand this from issue of highest "concern" to "*issues/areas to address*"

Add to list of "issues/areas to address":

- *"Public Perception Concerns"*
- Under "Environmental Concerns": (listed on document)
  - *"Cumulative effect"*:
    - Scale and size of operations—environmental and socioeconomic concerns
  - "Ocean use" under "Siting":
    - include, *"navigation"* (safety issues, navigation related to commerce)
- *"None of the Above"* (or recognition that there is no concern)
- *"Permitting Process"*
- *"Relationship to other forms of food production"*
  - Tied to regulatory production alternatives/ foot print
  - For ex., aquaculture is a positive net effect for protecting listed species, because fishing overseas has no Endangered Species Act (ESA)/ Marine Mammal Protection Act (MMPA)
  - Keep trade-offs in mind, recognizing aquaculture doesn't occur in a vacuum

Purpose of this exercise is to inform science needs

Multi-voting results: Where dots (votes) landed, and why these issues are important:

1. *Siting:* [**10 black dots; 14 yellow**]
   - Seen as umbrella category that catches a lot of other issues/ holistic consideration;
   - NIMBY issue;
   - Conflicts with other uses;
   - Misconception that we can site anywhere in ocean when realistically there are many challenges to uses;
   - Importance of navigation especially to Corps with purpose of ensuring commerce;
   - Immobile/non-transitory use
2. *Permitting Process:* [**7 black dots; 12 yellow dots**]
3. *Cumulative Impacts*: [**3 black dots; 5 yellow dots**]
4. *Nutrient enrichment:* [**2 black dots; 9 yellow**]
   - Nutrient enrichment: can kill/contaminate fish, algal blooms, etc.
5. *Feed, Fishmeal:* [**1 black dot; 7 yellow**]
6. *Protected Species:* [**1 black dot**; **7 yellow**]
   - Highest vulnerability for litigation
7. *None of the above:* [**1 black dot; 4 yellow**]
8. *Biodiversity/Ecology*: [**1 black dot**; **4 yellow dots**]
9. *Invasive Species/nonnatives*: [**11 yellow dots**]
10. *Disease*: [**11 yellow dots**]
11. *Drugs & Therapeutants:* [**4 yellow dots**]
12. *Relationship to other forms of food production* (tied into regulatory process alternatives/footprint): **[3 yellow dots]**
13. *Chemicals (heavy metals):* [**3 yellow dots**]
14. *Genetic Risk:* [**3 yellow dots**]
15. *Escapes (Offspring & Adults):* [**1 yellow dot**]
16. *Feeds (feed conversion and Growth Efficiency):* **[0]**
17. *Permitting Process:* **[0]**

Review (James): permitting process is concern, but the idea of this exercise was not to debate public perception issues; rather to get down to decision-making competence. In other words, what does your agency need more of in terms of knowledge/science to be more informed and have confidence to make regulatory decisions.

11:15 BREAK AND REFRESHMENTS (10 minutes)

OFFSHORE AQUACULTURE STATE OF THE SCIENCE MEETING
Facilitators: *Rich Wilson and Jerry Schubel*

Based on this morning's discussions: not about the "if" but about the "how" of developing aquaculture.

We haven't done good job of telling aquaculture story, and haven't put it into context of other industries.

Presenters: *Mike Rust, NOAA National Marine Fisheries Service*

Theme of talk: *change* ("The only thing that is constant is change")

Now using plant based feed for fish production. Don't need animals to feed animals.

Inverted "U" curve:

- X axis=economy or time (but can be different); Y axis=environmental impact
- Based upon empirical observation that technology or affluence increases and production increases, environmental impacts get worse, but then there is a turning point where environmental improvement occurs
- Turning point can be based on technological development, time, or other factors
- What we think about in terms of environmental impacts to aquaculture depends on which part of the curve we see (for example, high point of curve is like race to the bottom). Flattening out is some technological change. Downward slope is production under acceptable environmental impact
- Which part of the curve we see depends on who we are (ex., scientists are at beginning of curve; public and special interest are at front part of curve or end)
- Seen in numerous cases: farmed salmon example, antibiotic use example, escapes, fishmeal use (waste from produced fish can be used as feed), etc.
- Goal: make curve as quick and short as possible

OMEGA model: what works for specific region and species

Jack Rensel, System Science Applications Inc.

Environmental effects of offshore fish aquaculture in the Southern California Bight

Benthic Effects:

- Most commonly measurable and regulated effects of net pens worldwide are benthic (sea bottom) effects
- Fish farm particulate organic matter (POM) is rich in nutrients but can be assimilated by the sea bottom food web if provided at consistent low rates
- In the past, nearshore net pens effects have ranged from beneficial (increased food web diversity at low organic loading rate) to adverse effects (extirpation of most species except opportunistic and pollution tolerant species)
- Classic Pearson-Rosenberg organic enrichment model describes the range of effects.

Increasing particulate matter loading shifts seabottom surficial layer from aerobic to anoxic conditions; species diversity may decrease as sensitive species are extirpated. This can be avoided entirely with planning and modeling so that the aerobic populations of organisms in the sediments are maintained

- Generally benthic effects are "near field" i.e., local, under and near pend, not remote
- "Physics rules": Modest current velocity and direction are essential for resuspension transport and food web assimilation of organic wastes; velocity and depth work together. It is impossible to predict accurately the fate of wastes without simulation software. Some general guidelines for siting have been developed in other regions, but for open ocean the farms may have to be large to be economically sustainable and the costs of modeling are minimal compared to trial and error approaches
- Prior work suggests minimal effects at 90m deep in Sothern California Bight for commercial sized fish farm
- Farm location goals should include planning and modeling proposed sites to have little adverse effect on sea bottom or a beneficial effect
- Monitoring protocols have been developed worldwide in many countries. It is essential to learn from others' experience. Some form of benthic organic matter measurement is commonly used in countries with major fish farm industry such as Chile, eastern Canada and most commonly in other states in the U.S.
- Surrogate measures such as sulfide measurement have been used elsewhere, but the method requires a high percent of sediment silt and clay. This usually means low current velocity and lower benthic carrying capacity and the probe method produces highly variable results

Higher food web effects:

- Stable isotope tracing research near marine and Columbia River fish farms suggests that organic enrichment effects extends beyond the benthic food web to embellish food supply for higher trophic levels including marine birds
- In Puget Sound, fish farm areas have abundant wildlife including orders of magnitude more migratory sea birds such as surf scoters than surrounding similar habitats without farms
- Over 100 species of invertebrates and seaweed found on and around nets with no invasive, noxious species
- Large commercial fish farms in Washington State operate only in non-nutrient sensitive water column areas where light, not dissolved nitrogen, controls phytoplankton abundance. No farms are located in shallow, backwater areas that are poorly flushed and already affected by other sources of human-caused nitrogen waste loading

Coastal Eutrophication:

- Marine fish and salmon produce ammonia and often some urea. It can be measured in the field but laboratory studies combined with advanced 3D circulation modeling can produce more accurate effects estimates than measured
- Worldwide the contribution of fish farm to coastal eutrophication is small, but planning and advanced 3D modeling to examine effects of multiple farms is needed if the industry is

going to expand to a much larger scale
- Many types of NPZ (nitrogen-phytoplankton-zooplankton) models are readily available and have been incorporated into fish farming models

Summary:
- Tools required are planning, modeling and GIS
- Improperly cited or operated net pens can have adverse biological effects
- People are confused because a lot of literature is from "old days." Need to work with industry to understand effects and where to place farms. Lessons to learn from other areas
- Adverse benthic effects: near field and avoidable
- Coastal eutrophication: hard to measure, but net pen aquaculture can be sited to prevent furthering the problem by planning and modeling
- Modeling and monitoring tools serve dual purpose: to protect environment and optimize fish production
- Mistakes made elsewhere can be avoided, best to consider what others have done

Questions/Comments:
- Challenges with measuring waste dissolved nitrogen, due to large variability of downstream plume. Not simply a matter of measuring the concentration, but rather the physical transport x the concentration = flux. Physics is more advanced than biology, and so many models available, so use tools from physical and biological oceanographers
- Question (Dave Caron): Given some locales with low dissolved oxygen (DO) levels, expected to get worse, do we see this as primary driver for locating aquaculture sites?
  - This should be considered. Southern CA Bight is very heterogeneous/ some locations with low DO, mesoscale can change patterns. The problem areas tend to be much further offshore
  - See www.AquaModel.org for fish farm modeling information

Kevin Amos, NOAA National Marine Fisheries Service

Perspectives on Aquatic Animal Health

Background:
- To protect wild and farmed fish from diseases/dealing with disease; facilitate safe and effective commerce

Objectives:
1. Science of preventative health programs
2. Treatment schemes
3. Future needs of science

Challenges of farmed fish
- Relative high density

- Open system; many dynamics that can affect farmed site, and infections can occur, manifesting in disease

Prevention

- Any animal health program relies heavily on prevention
  - Veterinarian team/aquatic animal health professional,
  - Biosecurity measures
  - Avoidance of stress
  - Stock pens with healthy populations
  - Routine monitoring with robust record keeping
  - Use of vaccines (reason fish farming has reduced antibiotics so much is due to development of very effective bacterial vaccines)
  - Consider regulatory approaches like Gulf Fisheries Management Plan (FMP); gives a good idea of what is important to protect health of fish and area outside of fish

Infectious pathogen considerations:

- Variety of bacterial, viral and parasitic pathogens are endemic in ocean wild populations
- Most serious events occur where native disease meets non-native species
- Disease occurs (whether in wild or farm) where you have:
  - Susceptible hosts that are compromised and sufficient dose of pathogens
- Management of bacterial disease:
  - Vaccine
  - Don't use antibiotics as prophylactic like in other animal production; Work with a veterinarian to prescribe and use antibiotics as necessary.
- Management of viral disease:
  - Limited vaccines (aren't as good as bacterial vaccines)
  - Can remove infected population in some cases
  - Avoidance
- Management of ectoparasites:
  - Hydrogen peroxide,
  - Integrated pest management

Research and future prospects:

- Ongoing research for viral and parasitic vaccines
- Improved immersion delivery systems, oral vaccines, safer adjuvants
- Immune response research needed
- Aquatic Animal Drug Approval Program (U.S. Fish and Wildlife Service): need money for approval process
- Investigational New Animal Drug (INAD) use and reporting is critical to securing new, safe drugs for aquaculture production.
- Genetics:
  - Important tool. Potential to improve disease resistance just like other species in animal agriculture

- Could use tools like sterility of farmed fish if concerned that genetics are different from local stocks (and a significant escape occurs).

Bottom line: risk analysis is powerful tool to assess health fish and to fish farms

Questions:

- Data on parasiticide residues around sites:
  - Response: There is data, not aware of baseline information—most studies are on persistence of antibiotics.
- What are effects in offshore sites (versus other sites):
  - Water quality is better, more room, improved residuals in soils, lower risk of disease than near shore location
- Is there any data indicating the impact from use of hydrogen peroxide?
  - Not any impact from data we have, because almost immediately dispersed/disassociates into H20

Carol Price, NOAA National Ocean Service

Report: Marine Aquaculture and the Environment

- Focus on marine cage culture in open ocean: state of science report that can be used by industry and regulators to provide scientifically based platforms for making decisions

Water quality impacts:

- Fairly negligible—dissolved near cage (within about 30m)
- Secondary effects: quick assimilation of dissolved nutrients into food web and little evidence of links to algal bloom (concern is more on algal bloom impacts to farmed fish)

Benthic chemistry and benthic community:

- Strive to keep organic carbon loading low, keep seafloor away from anoxic state/keep sediments from accumulating on seafloor
- Goal of Benthic community: diverse community of organisms
- Strategy: looking at monitoring protocols to detect impacts early and use of adaptive management

Chemicals

- Best Management Practices (BMPs) to decrease chemicals used and negative effects of them (more details in report)

Ecological role that these farms play in ocean:

- "Fish attractant"
  - Wild fish are attracted to farms: find shelter and eat the organic matter coming out of farm; consume 27-80% of organic waste

Effects on sensitive habitats:

- Coral, sea grass and mangrove
- Avoid siting near sensitive habitats to minimize impacts

Protected Species and Aquaculture Interactions:
- Working more on this subject matter now: trying to pull together information and will publish state of science report soon analyzing what we know and don't know in the form of a risk assessment or needs analysis
- Preliminary results: few reported mortalities of protected species with shellfish and finfish aquaculture
- Seals and sea lions at highest risk due to depredation permits in Canada and overseas; Depredation permits are not available in the U.S., Non-lethal methods of deterring are preferred.
- We know a lot about how fishing gear interacts with protected species, so want to analyze whether or not this is analogous to aquaculture; analyze what's similar, what's not, lessons learned from fishing gear

<u>Questions:</u>
- Are pinniped take permits available in the US?
  - Response: not currently issued in the US for aquaculture
- Is this assessment global or regional?
  - Response: Assessed global research, but only for countries that had studies written in English;
- Need for effective monitoring; who is doing the best job monitoring and how are they divvying up responsibilities?
  - Response: A lot of monitoring is covered by permit applicant (any marine mammal interactions are required to be reported, etc.), but also independent researchers doing visual observations and information from farms (anonymous farm in whale sanctuary—no negative interactions so far)
- Are we looking at integration with other forms of industry, (like integrating aquaculture with offshore energy structures)?
  - Field of combining many farms together and nutrients from one to feed next trophic level up (Integrated Multi-trophic Aquaculture)
  - Co-siting with other industries is great interest but not being done currently in any big scale
  - Workshop in Rhode Island about co-locating with wind farms, but realistically not seeing a lot of wind farms pop up—they also face challenges in terms of permitting

12:45 WORKING LUNCH

1:45 OFFSHORE AQUACULTURE STATE OF INDUSTRY MEETING
<u>Facilitators: *Rich Wilson and Paul Olin*</u>

What does the industry want, need, or face going forward? What is the technology at issue?

What is the environmental performance and impact of technology? What are the non-technical barriers?

Presenters: *Don Kent, Hubbs SeaWorld/Rose Canyon Fisheries*

Rose Canyon Fisheries: Background

- Been working on offshore finfish operation development for over a decade
- Seeking to produce finfish in offshore cages in Southern CA
- History: tuna in San Diego
- San Diego currently has about 1000 metric tons of seafood, most from single lobster fishery
- Compared to CA agriculture: aquaculture is less than 0.5% of overall livestock production in CA
- Basic principles are similar to livestock agriculture

Project specifics:

- Scale up to 5,000 metric tons annual production; annual sales of $50-80 million
- Species:
  - Yellowtail Jack (*Primary species. Most of yellowtail we eat is farmed in Japan currently),
  - White Sea Bass,
  - Striped Bass
- Proposed site 4.5 miles off San Diego coast.
  - Worked with Navy and recreational & commercial fishermen to pick site.

Permits required: pioneering regulatory process

- From Environmental Protection Agency (EPA):
  - National Pollution Discharge Elimination System (NPDES)
  - EPA as National Environmental Policy Act (NEPA) lead for NPDES permit
- US Army Corps of Engineers (USACE):
  - Section 10 permit
  - Related: NOAA interaction on Essential Fish Habitat (EFH), Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA)
- Coast Guard:
  - Aids to navigation permit
- CA Department of Fish and Wildlife (CDFW):
  - Aquaculture registration
- CA Coastal Commission (CCC):
  - Coastal Zone Management Act (CZMA) consistency determination

Why San Diego

- Mediterranean climate, shaded, low wave energy
- Existing commercial fishing
- Proximity to southern California markets

- Regional scientific expertise with academic institutions, Hubbs-Sea World Research Institute (HSWRI) and NOAA

Potential economic benefits
- Net sales, 8 years out: upwards of $80 million. Potential economic benefit of $117 million

Addressing stated concerns:
- Have addressed environmental concerns already, for example avoided EFH and impacts on existing fishing operations
- Entanglements:
  - Using state of the art netting (tension Keko net) which won't ensnare other animals; designed to minimize habitat impacts
  - While fishing gear is designed to ensnare animals, aquaculture gear is designed to cage them in; do not confuse fishing entanglement issues with aquaculture practices
- Side benefits:
  - Develop marine spatial planning. As they develop models for where aquaculture can occur, this project can provide hard empirical data
  - Opportunity for us to take new tools being developed and test/validate them
- Slow initiation/expansion:
  - As farm expands, can make sure we are not having an adverse impact. If negative impact after 4 cages, will mitigate for it.

What is needed:
- Permitting review process that will bring all agencies together, clearly define process
- Educational outreach that balances concerns with potential benefits
- Public recognition that this will support existing coastal jobs and create more

Size comparison/ context for project
- To feed all of California, could do it theoretically with a 1.2-mile diameter cage. That would create 21,000 jobs; $3 billion/year industry
- Compared to any other animal based protein, freshwater use and land use is minimal

"Sustainability"
- Conserves resources, does not degrade environment, technologically appropriate and economically, socially acceptable
- Most ecologically sound form of animal based protein

National Aquaculture Act of 1980
- National policy to encourage development of Aquaculture in US
- Not living up to its mandate (still importing 91% of seafood)

National Strategic Plan for Federal Aquaculture Research (2014-2019):
- Developed 9 priorities to drive aquaculture research and development, each of which would

benefit from real life model/farm to study to measure actual impact
- Farm expansion over time will give researchers and agencies opportunity to understand issues

Alternative:
- Expansion in Mexico, (12 Mexican farms requesting juveniles) then importing fish back here. It shouldn't be that way—jobs should be here

Trying to show people how this can be done, encourage new paradigm for growing seafood in nation and region

Alan Cook, Icicle Seafoods Inc.

Icicle Seafoods:
- US Seafood company, active in Alaska.
- Farming operation in Puget Sound. Sell overseas, etc. pretty diversified

US consumption of Salmon (Atlantic Salmon):
- Consumers accept farmed salmon: buy farmed Atlantic Salmon, amount is growing each year
- No new sites permitted on West Coast in 20 years
- 2010: all farmed fish surpassed beef production globally (internationally). Norway produces 50%--tiny coast, good environmental track record

Feed efficiency
- Use 20% fish meal and oil; rest is corn, soy, canola, wheat, poultry byproduct
- Not a net user of marine proteins (maybe used to be); feed conversion ratio make is such that they are a net producer of marine protein
- Compared to other protein: most efficient

High cost
- Capital investment cost for offshore farm: very high (about $5 million before any fish are included)

Siting:
- Strait of Juan de Fuca: well under 1% of available area

Technology:
- Standard gravity cage (used in Australian tuna industry)

Challenges:
- Scale:
    - Need scale that justifies offshore location, have to start big to be cost effective

    - Need infrastructure to lift nets, cages, clean them, etc. to operate on big scale
- No one with this expertise in US; recruitment for skilled labor

Permitting
- Extremely complicated. In WA state need 11 permits, from Fed, State and Local agencies
- In WA: JARPA→interagency consultation or pubic comment→ permit determination→appeal process→permit issuance
- Hasn't been new permit in WA in 20 years, because unless you pass 100% of everything you have nothing. All opponents have to do is inject doubt in any person issuing permit. Process is designed for failure

Financing
- A lot of uncertainties: permitting and regulatory risk. Investors want to know if you can get a permit, and answer is always maybe
- Operational risk (fish) and market risk (prices); starting business from scratch; overseas; working capital; etc.

Conclusions:
- Feasible to develop in US, and can help develop economies in poor coastal communities
- Reduce reliance on imported seafood
- Create incentives for investment

<u>Questions</u>
- Investment here versus overseas—costs of producing here versus say Chile; and difference in quality?
    - Response: Quality is similar, but ours is fresher and could be lower cost (US consumers pay cost of flying overseas fish here)
- In complex permitting process, from industry perspective, what part of process is the least regulatory confident?
    - Response: WA state NPDES permit is scientifically driven, but process comes bogged down in public comment period—often comments with no scientific background.
    - Also consultation with tribes—treaty law, no obligation to adjudicate at all
- If no permit issues/barriers, confident that seafood industry in US would actually be competitive in long term?
    - Response: No reason why people in Chile should be more efficient at this than us. In WA, could expand 10x without any negative implication and lots of economic positives
- Do other countries do things where you can take over someone else's existing lease, with minimal new environmental review?
    - Response: Not sure. But idea to designate certain zones as aquaculture zones would solve uncertainty around planning
    - Norway issues number of permits
    - Humboldt Bay Pre-permitting project

Logan Kock, Santa Monica Seafood Company

Value aquaculture provides to supply chain

Seafood supply chain summary:
- Wholesalers
- Brokers-producers
- Farms themselves
- General importers
- Within this, a lot of issues:
    - Reliability of supply
    - Traceability/transparency
    - Sanitation/handling
    - Hard to control chain
    - Logistical aspects and vulnerabilities associated with supply (cost-energy, tariffs, strikes, etc.)

Value AQ provides to supply chain:
- Import about 85% or products and 90% of farmed products
- Domestic supply has potential to reduce negative issues/logistics from sourcing side, and provides supply side alignment in terms of production and use, cost, waterfronts, etc.

Needs:
- Between niche farms and mainstream stuff, need mainstream stuff, like Rose Canyon or Icicle farm
- Need regulatory environment that allows those projects to exist

2:45 ENVIRONMENTAL AND OCEANOGRAPHIC DATA FOR FARM SITING AND MODELING

Presenter: *Cisco Werner, NOAA National Marine Fisheries Service*

Assets and Data Products for Southern California Bight (SCB)

There is a wealth of environmental information, surveys and observing capabilities for the SCB. Two of these are CalCOFI and SCCOOS.

California Cooperative Oceanic Fisheries Investigations (CalCOFI; *http://www.calcofi.org/*):
- Multi decadal background of data for fisheries (1949-present)
- Data available online *http://coastwatch.pfeg.noaa.gov/erddap/search/index.html?page=1&itemsPerPage=1000&searchFor=calcofi*

Southern California Coastal Ocean Observing System (SCCOOS; *http://www.sccoos.org/*), a

component of Integrated Ocean Observing System (IOOS; *http://www.ioos.noaa.gov/*). Goal: to provide info to decision-makers; Brings data together from points along the SCB onto a single website. Examples of available information (*http://www.sccoos.org/data/overview/*) include:

- Harmful algal blooms (HABs), moorings, outfall, currents, sea surface temperature (SST), salinity, etc.
- Publically available
- Plume tracking and frequency radar—measure surface currents
- Data is fed into models. Model that runs along CA—tells you what system looks like now and it provides a 3-day forecast
  Glider lines and data (*http://www.sccoos.org/data/spray/*). Transects extend over 500 kms offshore, with measurements that include salinity, temperature, velocity, fluorescence, dissolved oxygen (DO), aragonite saturation

Remotely Operated Vehicles (ROVs) for acoustic and optical observations (*https://swfsc.noaa.gov/textblock.aspx?Division=FRD&ParentMenuId=294&id=16794*)

All forms of monitoring come together to provide an integrated picture of biological, physical and biogeochemical conditions.

Data Gaps:

- Scale (offshore aquaculture sites may require monitoring, surveying and modeling at smaller scales; the capabilities are in place and need to be tailored to individual locations)
- Benthic environment (methods are also in place, but need to be tailored)
- Genetics/Genomics (new approaches in genetics can provide information on species composition, micro-biomes, etc., that we did not have in the past. These techniques look quite promising)

Questions/comments:

- Other data sets: San Pedro Ocean Time Series (data sets with different scale; have collected since late 1990's)
- Is there a way for regulators and applicants to get more in tune with what data sets are available?
  - Response: Piggyback on existing sites (adding a sensor); working with local agencies
  - Funding is coming from federal agencies, but need connection. Examples: SCCOOS data supported by NOAA and is publically available—challenge isn't getting it but integrating it with other datasets and interpreting it
  - ***Proposed Action Item:*** **try to create communication information sharing mechanism so all relevant parties have information they need. (We have appropriate databases that need to be known to entities that need the information)**

Kenneth Riley, NOAA National Ocean Service

Aquaculture is growing fast. Increasing footprint in coastal zone. Science tools to support

coastal aquaculture and coastal zone management

Coastal aquaculture has opposition/ concerns

Products to help support good decision-making about marine aquaculture:
- White papers, peer reviewed science, etc.

CAPES: Coastal Aquaculture Planning and Environmentally Sustainability
- Environmental models (AquaModel, Farm Aquaculture Research Model [FARM]), Marine spatial planning, tool and data center
- All about assembling tools for decision-makers
- Coastal aquaculture planning portal: Digital Coast platform
  - Will make available to public soon
  - Visualization software for aquaculture development
  - http://coast.noaa.gov/digitalcoast/

Aquaculture in Southern California:
- Great opportunity in SoCal
  - Marine spatial planning and potential economics
  - Rose Canyon would be first commercial scale demonstration; also research opportunity
- Economic projection could be $1 billion/ year industry
- Coastal Atlas and Planning Guide (CA AquaView)
  - Siting tool to help coastal manager. Help guide where to place aquaculture in coastal waters
  - Leveraging data from different programs within NOAA
  - Identifying suitable and unsuitable areas for aquaculture, find use conflicts
- What industry would look like:
  - Aesthetic impact is barely visible in reality
  - Used model and graphical software (CANVIS) to simulation impact on coastal landscape
  - CANVIS is a free software package. http://coast.noaa.gov/digitalcoast/tools/canvis
  - Simulation of visual impacts using georeferenced scaled objects (when you're on the sand, the Rose Canyon farm is not visible from the horizon)
- Environmental impacts
  - Framework to evaluate marine aquaculture models
  - AquaModel and DEPOMOD
- Research Goal/Expected Results:
  - Environmental models that can be used for aquaculture siting and operations. Taking a few models to simulate environmental effect of Rose Canyon project
  - Expected results and project benefits: identify thresholds and effects

<u>Jack Rensel, System Science Applications Inc.</u>

AquaModel: Computer Modeling of Net Pen Effects

**Technical difficulties with presentation; break: 3:45-3:55*

3:45 BREAK AND REFRESHMENTS

3:55 OCEAN USE AND SPATIAL PLANNING IN THE SOUTHERN CALIFORNIA BIGHT

Steve Gaines, University of California Santa Barbara

Spatial Planning for Open Ocean Aquaculture: False vs. real trade-offs

- How to take data and models and objectives people have, put together into comprehensive framework.
- Thinking about formal way of looking for different kinds of trade-offs: false and real. Have to be careful in looking beyond our own narrow piece of the system—look holistically

Trends in production:

- Meat production is growing, and fish production is growing faster than overall meat growth globally. Problem: in 2050, the growth is huge

Global Effect of growth:

- GHG Emissions:
  - Relative to other forms of meat production and agriculture: lower GHG emissions than almost all other animal agriculture
  - If we were going to produce all protein by beef, would add 81% China's GHG emissions, or 130% MORE total US GHG emissions. Aquaculture would be adding about UK GHG level
- Land use:
  - If we were going to use lamb/goat—would need 85% South America additional by 2050. For Aquaculture: would take less than the continental shelf of New Zealand for same protein production
- Freshwater:
  - For agriculture, would need additional Lake Huron each year; or for aquaculture can do with less than a bucket
- Main point: these are HUGE differences in terms of global effect. Anything that leads to a trajectory more towards marine food supply is good for the planet

Analytical tools to assess tradeoffs

- Spatial planning: Marine Spatial Planning (MSP) helps balance multiple ocean uses
- Can be mapping exercise, but activities in the Ocean move, so interactions happen across scale.
- To approach problem of variety uses, draw on economics literature to think about allocating sparse resources to build products
- Scenarios:

- Finfish net pens, bivalve longlines, seaweed longline

<u>Trade-Off Analysis:</u>

- First, people have to be able to articulate things that they value
  - Example: wild fisheries and aquaculture. Can have management outcome to illustrate trade-off, or where aquaculture will displace wild fisheries. But can also find value with higher values for both—in which case there is no trade-off. If you can explore and plot every management option, get outer bounds=efficiency frontier, or optimal choice of conditions
- Found:
  - Stakeholders emphasized extreme ends of the spectrum with real strong trade offs
  - Then, looked at millions of MPA proposals and found options that were dramatically better in both aspects. (Choices were never explored, because no one evaluated all of the options before)
- There are multiple "best options." Choosing between different options depends entirely on how you value the 2 axes
- Use these projections to have more informed discussion of consequences to different aquaculture scenarios
- Applied to 3 scenarios: *finfish net pens, bivalve longlines, seaweed longlines:*
  - Constraints: precluded outright in certain areas
  - Developable areas: (limited to 100 m depth for this study); looked at factors that effect growth, cost, production of mariculture; also used mariculture effects on the system (negative and positive)
  - For 3 species, put together suite of models. Still putting together results (some models available now, for ex., 10 year net present value for each three, then put together for "most valuable sites" for each species)

Analyzed *wild fishery, viewshed impacts, benthic effects,* and *disease risk* for *finfish net pens, bivalve longlines and seaweed longlines*:

- 7 different axes possible, so a variety of different plans
- Assign number different scenarios, anywhere from 1-100 (1 is worst, 100 is no tradeoff);
- Mapped in 2D; and 7D "graph" of values
  - 7D view is helpful to see which options are high among multiple dimensions, and where trade offs actually are
  - This analysis forces us to articulate what we really value from effects of different scenarios
  - Can see where the real values and real trade offs are, versus solutions we shouldn't even be considering (bad for multiple factors)
  - Potential to reduce conflict and produce better outcomes; informed decisions

<u>Questions:</u>

- How many parameters are in a 7D forecast?
  - Response: Get more and more elaborate models with more parameters. Here there are

dozens, but tend to be basic aspects of biology. Comes down to which parameters are really important for influencing management, and that will likely be much smaller

- Validation for model?
  - Response: Challenge is that we need sites big enough in scale. Possible to also use surrogate sites in other countries
- Stakeholder involvement: For example with Marine Protected Areas (MPA's), stakeholders are deciding qualities we want in our Oceans and leaving details to the experts; but people can be uninformed
  - Try to get science involved in way that is accessible. Science won't tell you what to choose, but making the information readily accessible will help them/ at least explore other proposals
- Map of shellfish versus finfish aquaculture potential sites, included in 7D graphing? What about negative locations?
  - Response: 7D graph includes shellfish and finfish sites
  - Did not do trade-off analyses for poor locations—only done for profitable locations; people in industry should be able to tweak for individual location; this is tool for industry planning as well
- If we had interest in going further north, could choose different species other than striped bass?
  - Response: yes. Idea is you grow different things in different places, so could look at same kind of projections for other species
- Comment: this can also drive research in terms of beneficial interactions with system, and sometimes issues that only arise when you look at complex interactions

4:15 AQUABRIEFS TOWN HALL MEETING

Open forum for lightning talks (5-min presentations). Speakers were encouraged to share cutting edge and emerging science related to offshore aquaculture and environmental interactions. Slide presentations were encouraged, but are limited to a maximum of 2 slides.

Corey Peet: Seafood Watch

Seafood Watch is the strongest brand in North America

How they actually evaluate aquaculture operations:

- Elaborate categories and criteria. Each assessment backed up by report, online at *Seafoodwatch.org*
- Opportunity to work together for sustainable seafood. Example of aquaculture industry in New Zealand in "green"
- **ACTION ITEM: Corey Peet will share PDF's that talk about how the Seafood Watch Program makes recommendations, aquaculture criteria, and link to fisheries, etc.**

Questions:

- How are criteria weighed? Is there opportunity to provide input on validity of reports?
  - Response: every report is available online, and for every recommendation there is a report
  - Idea is that every single number is thoroughly justified. He can send background document that lays out that process
  - Also have technical advisory committee—would like to bring aquaculture expertise to that
- How is advisory committee is formed?
  - Have to line up with principles more or less; technical expertise in aquaculture represented
- How do they address international barriers (language issues, etc.) that can reduce data availability?
  - Can only work with what they can get. If they can't understand it, can't evaluate it, so put in the "middle" of the issues
  - Criteria is set up to deal with those unknowns
- Why is the individual fish farm he pointed out evaluated differently?
  - External Assessment Program: allows producer/buyer to come to Seafood watch and ask them to assess. Fee goes to pay analysts and reviewers, then gives recommendation. Pseudo-certification scheme

<u>Mike Rust: NOAA</u>

"Pushing, pulling and creating change"

- Cumulative impacts from industry versus single farm: thinking ahead to cumulative impacts
- Bell curve:
  - Graph showing that industry will have to continue improving environmentally: all along one big curve from best practicing growers (would want to encourage) to ones you would want to discourage
  - Scenarios presented graphically: rewarding better actors, etc.
  - Curve to focus on: eliminating poor actors and encouraging those who are improving and moving forward. As regulators need to think ahead and recognize what lies where. Ideally, law would do that, but we don't have any environmental aquaculture law

<u>Questions/Comments:</u>

- Comment: same problem in fisheries: it's the bad actors that cause all the problems, but difficult for regulators to kick people out of game. Opportunity now to start it right, and create legal criteria for success upfront before any actors are already in the game. Can't go back and change the rules once people are already acting.
  - Response: regulations can dissuade people from even going into industry. Easy to overregulate situation
  - Response: if public decides to accept broadly acceptable offshore AQ and wants to set standards, now is the time. Real issue is inconsistent and unclear regulations
- Comment: laying the framework for potential regulation

5:15 CLOSING COMMENTS
Rich Wilson

How to Address Issues:
- Amount/type of science needed for decision makers to have confidence
- Have to engage public/shift perception
- Need to control source info on aquaculture
- Need to better understand how to influence decision-makers
- Need to problem solve on many known challenges/impacts
- Facilitate education of legislation
- Balance long term with short term impacts
- In absence of legislation designating "lead agency," agencies find a way to coordinate & lead
- Need to articulate story of aquaculture development
- Identify the best pathway to developing high standards
- Have to figure out most important target audiences
- Identify best people to tell the story

The facilitator provided a brief summary of the day's discussions.

- Industry spoke of its needs, reminder that this workshop was designed to further identify science needs to support decision-makers
- Key comments that grew from the multi-voting exercise:
  - Need to make compelling argument for development of this industry
  - Explore and understand needs of decision-makers
  - Public perception
  - Translate science to public
  - Specific environmental issues to address: siting, nutrients, protected species, cumulative impacts, some saw as non-issues, some identified permitting process itself as a concern
  - Industry representatives highlighted key goal was to figure out how to navigate permitting process

The group subsequently conducted a rapid brainstorm to begin determining how to address needs/challenges that were identified during the day's discussions? BRAINSTORM RESULTS:

- What level/amount/type/quality of science is needed for regulators to make decisions with confidence? (For ex., best available science has been presented, but hesitancy to accept it)
- Presumption that logic prevails in decision-making process, but scientific logic does not necessarily guide process—combination of science, public perception, human dimension
  - Need to acknowledge that there is more than science involved here
  - Need to engage the public and shift perceptions (education, outreach)
- Proposed CA Center for Aquaculture solutions:
  - Need neutral source of data; trusted source of information like Sea Grant or UC Davis or Monterey Bay Aquarium. Not to say all aquaculture is good, but move forward in informing public of what good aspects are
- Regardless of "green rank," people buy fish. Recognition of disconnect of the public who are engaged politically and those who vote with their wallets
- Have to accept premise that no matter how good the science is, some folks will argue against it
- Can't change regulations until public perception has changed; need to better understand how to influence decision-makers
- Don't want to educate entire "public," because most of public doesn't care. Need to target major voices (Monterey Bay Aquarium)
- Long term: need to also solve engineering problems, partner with universities like UC Davis
- In the meantime of all this, need to move forward in getting aquaculture program permitted

    - Passing legislation is extremely difficult and can take very long time. So also need to deal with the present, and look at based with what we've got, what can we do to permit facilities. Recognition of near term and long term need
- We have no legislative mandate or funding for aquaculture, so what is the solution? Can the agencies involved designate a lead agency/framework on the executive side? (Have SB 201 on state level)
- No more mandates needed, but we're not telling the right story (including science and public perceptions/anxieties)
    - All they're hearing is card with red designation. Decision-makers balance science vs what public will tolerate—which generally is poor because stories are poor. Need to get better at telling story
- Need constituency (which we don't have) because big companies are not pushing congress on this
- Take lessons from WA
- Tell the right story to right audience (political environmental activists)
- Get behind demonstration project. Set environmental bar high

5:30 EVENING RECEPTION AND NETWORKING EVENT

29-April Wednesday

800 WORKSHOP REGISTRATION AND HOSPITALITY BREAKFAST

830 WELCOME AND INTRODUCTION OF DAY 2 GOALS

Rich Wilson:

Day's Schedule and Changes:
- Jack Rensel's talk moved to today due to technical difficulties
- Roles involved and roles in permitting
- Transitioning into science needs
- Exercise: as a group what is needed/what recommended actions come out of this workshop to keep these efforts going

Jerry Schubel, Aquarium of the Pacific & James Morris, NOAA National Ocean Service

Focus today is primary goal of workshop: to identify barriers in permitting aquaculture projects, focusing on knowledge and science barriers

Real question is whether we have enough science to permit new projects, and if not, what questions do decision makers need answered? Or, is it not the science at all; is it about convincing influential people/groups that science is adequate?
- If this is more about convincing people, we need to do better job at telling the right story, right storytellers, and be assertive in telling positive story
- For ex., it protects wild stocks, environmentally preferable to other forms of animal protein,

etc. May need to focus on targeting environmental NGO's

Rose Canyon gives us exciting opportunity to get something in the water, study it, learn from it, consistent with precautionary principle

James Morris—NOAA

We are here to *build regulatory confidence*. The political process is important discussion, but different dimension to this problem. They interact, but, at end of the day when it comes time to sign permit/make decision, the majority influence on that signature should be based on *science*.

Yesterday: background

Today: regulatory process; what needs are

- Social process, working groups, etc., to inform scientists what the needs are.

Jack Rensel: System Science Applications Inc.

AquaModel: Computer Modeling of Net Pen Effects

Background:

- Complex models are not always better; more complex models can be worse predictors and be more expensive
- Sediment and water column conditions and species of fish cultured vary among ecoregions
- Unless a model can be adapted to a specific ecoregion, it will inherently be subject to a large amount of error
- Modeling is not a black box—helps understand the unknowns: conservation of mass (mass balance), momentum, and energy principals are invoked to be sure results are reasonable. Inputs must be reasonable well known
- Models require calibration and testing known as validation through a process known as sensitivity analysis. When modeling prediction is poor:
    - Physical circulation data may not be representative
    - Conceptual design assumptions could be incorrect
    - Input data or boundary conditions may be inaccurate
    - Conceptual model or coding errors are possible
    - Incomplete testing of less-well-known parameter settings could have occurred

AquaModel Uses:

- Concurrent 3D tracking and calculation of transformation of dissolved and particulate wastes from fish farms in high resolution (near field) and large areas (far field). Different nutrient streams (waste fish feed, fish feces, soluble nutrient waste) are tracked by use of ecoregion adapted versions of AquaModel
- Fish are held in virtual fish farms where they eat feed, consume oxygen, swim in the

currents, respire, and produce dissolved and particulate wastes that are tracked as they are assimilated into the food web

- The dissolved wastes are tracked through water column transport and uptake by phytoplankton that are consumed by zooplankton with their excretions remineralized
- The particulate wastes are transported by currents while sinking to the sea bottom where aerobic and anaerobic populations of organisms process the wastes
- The model has a user-friendly graphic-user-interface and produces a video-like output so the user can visualize the processes occurring while storing the necessary output data to statistically and graphically analyze the results
- The model runs within a full-fledged GIS that allows a huge variety of inputs from many data sources from buoys to satellite imagery
- AquaModel can provide confidence to anyone concerned about environmental interactions, as it is a mass balance model with all major coefficients and settings readily adjustable by an advanced user

AquaModel Validation:

- The model has been used in about 20 locations worldwide for government or industry clients and has been continually tuned, modified and improved for over a decade
- Model testing near Kona Hawaii and in Eastern Canada indicated good agreement between measured and modeled effects of small and large fish farms retrospectively. It is also being tested and tuned for use by the Chilean and Hong Kong governments to help manage their large industries
- The validation process begins by quantifying the degree of uncertainty and likely range of each key parameter
- Key parameters are then tested one or two at a time to quantify effects in tabular and plot formats for parameters that are relatively well-known and have no interaction with other parameters.
- The model is then fit with these best-fit settings and run many times while varying the remaining less-well-known settings to achieve the best overall fit
- Results are then rank ordered by best fit for single and multiple times

Real-time Model Demonstration: Rose Canyon Fishery site shown

- A demonstration of the organic carbon fate in terms of sediment delivery rate and resulting sediment concentration was shown. Viewers observed the actual waste stream tracks as particles descended to the bottom with thousands of tracks visible. Reaction of the seabottom to the organic wastes was viewed in 20-minute time steps
- A separate demonstration of the water column oxygen effects of the proposed fish farm were also shown, as configuration and positioning of the cages is critical to avoid low oxygen stress to the fish
- Five months of current meter data for all depths was used
- An additional five months of current data is being collected
- The model need additional calibration and checking
- Flow rates, nutrient bottom loading, sediment total organic carbon (TOC) rate, water-

quality, Nitrogen and Oxygen

Next Steps:

- AquaModel use is expanding worldwide, primarily for use by government but also increasingly by industry, as there are no other tools readily available for supporting aquaculture development in a sustainable manner
- AquaModel is being adapted to include seaweed farm modeling for economically sustainable removal of carbonates from seawater. The model will be tested at a large seaweed farm being built to test the concept of ocean acidification refugia for sensitive species as funded by the Paul Allen Family Fund

<u>Questions:</u> (especially encouraging regulators who have questions about this as a model to make decisions)

- Using salmon model as example, can you identify environmental thresholds? Will same thresholds be applicable in offshore environment?
  - Response: Yes, organic carbon appears to be a stable and repeatable measurement and is already widely used in the US and overseas
  - Some measurements change depending on the rate of current flow, like sulfide measurement by the probe method. Research is underway to improve this
  - Twenty years ago Washington State government enacted rules allowing sediment impact to only 30m away from sites. The farms have greatly increased in size since then but still meet those requirements through improved management, reduction of waste feed loss, reconfiguration of the sites through trial and error and better fish husbandry
- Should EPA set thresholds for open ocean aquaculture in the EEZ or should it be data gathering process?
  - Response: There are no existing fish farms presently in the EEZ and the idea with the Rose Canyon Fisheries site is to closely monitor the results to see what occurs, use the data to further validate the model and look at carrying capacity for more farms before they are permitted. Even poorly sited fish farms have benthic effects that quickly self-remediate when the fish farm is removed, only a few months in areas of modestly strong currents
- Can real time data from sensors in the environment be tied into the model?
  - Response: Yes. Data from all kinds of remote sensing is available via the internet and the model has polling utilities built in. This will help significantly in open ocean fish farm operations especially as current flows are not as predictable as inshore sites where tides are the major forcing factor
  - Southern California has a sophisticated Regional Ocean Model (ROMS) for estimating current conditions and forecasting near future conditions. We are currently using one version of this model that UCSB obtained from UCLA
- What is needed in terms of sampling (i.e., from Rose Canyon project) to help validate this model?
  - Response: bottom samples, with replicates; parametric statistics based on data, operational data such as fish biomass, feed used, mortality rate, harvest timing, transfer

of fish among cages, etc.

- Model could help instill confidence with regulators to help with permitting, but generally monitoring is needed to validate model assumptions.
- What is the appropriate cost-effective level of monitoring?
  - Response: modeling should inform and influence monitoring in terms of the selection of sampling locations from expected low and higher effects areas
- Washington State has been implementing something that requires monitoring already, correct? How is that implemented?
  - Response: Yes, the state has had monitoring for 30 years. Ten years under state water quality permits then 20 subsequent years under NPDES and CZMA statues that begin on the local, county level.
  - WA Department of Ecology manages CZMA and NPDES, and reissues permits every 5 years after considering new science and public input
- What does it cost as an operator to model?
  - Response: It depends on the country where used. In some countries, an applicant does not pay any money for modeling but has to provide the appropriate input data (e.g., a current meter deployment by a third party contractor)
  - Ideally, the model is also a tool that can the farmer can use to choose an appropriate site and configure the site to be most economical and ecological. The two goals are not mutually exclusive and actually mesh together
- What initial investment would be needed for a state looking at adopting monitoring/modeling?
  - Once the model is setup for a specific region or ecoregion, the costs are minimal. A current meter record can cost $5,000 or more, but in the near future we may be able to use high-resolution 3D models as they become available. Model use can be contracted out to a third party consultant in the event that few permit applications are tendered
  - Some regions of other countries already use models for issuing net pen permits, but they have existing large net pen industries

845 THE LEGAL & REGULATORY ENVIRONMENT: OFFSHORE AQUACULTURE PERMITTING
Facilitators: *Rich Wilson and Diane Windham*

Regulators and decision-makers were invited from state and federal agencies involved in offshore aquaculture permit review to participate in a discussion on the permitting process. The aim of the session was to identify barriers to permitting aquaculture projects and identify what is needed to clarify and improve the permitting process.

Diane Windham: NOAA

Reference to handout: "*Offshore Aquaculture Federal Permitting in CA"*

- Illustrates that permitting aquaculture in Federal Waters is a complex process with multiple agencies involved, and we're still figuring it out
- Rose Canyon will likely be first test case for moving forward in a regulatory framework for

offshore marine fish culture
- Each of the agencies on the handout has discreet questions, but all comes into one regulatory framework. Would like to understand what questions are to inform framework

Inter-Agency Working Group for Rose Canyon
- Convened inter-agency working group for Rose Canyon Fishery offshore project
- Only one meeting so far, could potentially serve beyond Rose Canyon Fishery for other projects in federal waters in the future
- Regulators and decision-makers from state and federal agencies involved in offshore aquaculture permit review
- Goal for this session: identify barriers to permitting aquaculture projects and identify what is needed to clarify and improve the permitting process

Questions:
- State agencies not included in handout?
  - Response: focused on agencies with federal authority—permitting in federal waters
- Useful exercise: link topics to ultimate agencies responsible, ideally have "go to" agency Someone should be in charge, and list will help inform who has authority/expertise where
  - **ACTION ITEM: Link environmental topics with agencies' roles**
- Do multiple agencies feed into same topic?
  - Response: yes. Maybe more could be done so issues can be linked to responsible agencies and issues can be mapped to multiple responsible agencies

Presenter: *Alan Everson, NOAA National Marine Fisheries Service*

Aquaculture in Hawaii:
- Problem:
  - Frustrating, complex permitting process in Hawaii
  - To attempt to resolve, focused on one "stumbling block"—each agency looking for something slightly different in their monitoring plan
- Proposed Solution: working group
  - Organized group of permitting agencies together to look at monitoring for offshore aquaculture in general
  - Started group 3 years ago to address concerns regulators had with offshore aquaculture
  - End goal: monitoring protocols that meet NPDES protocols
  - There are 3 big agencies in Hawaii in federal level: NMFS (EFH, ESA), local EPA office (Clean Water Act [CWA] Section 404, water quality impacts), US Army Corps
  - Group provided forum for folks to discuss impacts. Discussed individual projects—like pre-consultation meetings
  - Started with agency folks, then eventually invited actual applicants to participate. Keeps growing
- Status of group now:
  - Group meets every 3-4 months

- Seemed to have turned things around. Eliminated need for applicant to meet individually with each agency—provided forum for one large meeting
- Sub-group formed to draft standardized protocols
  - Made up of each individual agency, meets more often to identify needs of each agency's particular monitoring plan. In process now for coming up with standardized protocol that all agencies can accept for monitoring portion
- Forum and space for communication (clear up miscommunications, misunderstandings, etc.)
- Alan maintains role as communication conduit between applicant and agencies

Questions:

- What kind of permits and how many projects have been permitted in Hawaii? (Translation to projects in the water)
  - Response: A handful of projects and proposed projects (around 5)
  - Big project was New Ocean Mariculture expansion. Initially there was a lot of opposition, but tone changed and process went a lot smoother after effort was made to educate the public/forum to receive comments from agencies
- How long from start to finish for the Velella Gamma (Kampachi Farms) project in Hawaii to get permitted?
  - Response: About a year (needed a more rigorous review because of the lawsuit involving their previous project.)
  - Reaction to this/comment: feeling that coordination is a key issue here, like Hawaii. Diane is working on it, and think we're on the right track
- Comment: more than communication, leadership is crucial. Relationship that Alan has with regulators in that working group is key. Holds consistent meetings and agendas
  - Response from Alan: also intended to educate regulators with science
- What economic incentives do ports and regions have for aquaculture in federal waters, versus state waters?
  - Response: right now, in federal waters there are just a couple entrepreneurs; all projects he was talking about are in State waters. Projects in Fed waters probably wont happen for another couple years

10:00 AQUACULTURE ENVIRONMENTAL INTERACTIONS: SCIENCE NEEDS AND USES

Facilitators: *Rich Wilson and Paul Olin*

What are under-utilized and potentially high impact research topics that need more attention to advance marine aquaculture in southern California? Have research and knowledge transfer systems within the region been mapped to assess intellectual and technology assets to support the aquaculture industry?

Panel of regulators involved in permitting offshore aquaculture projects in federal waters was convened to answer the above questions:

	Role	Needs
John Bannon (USCG)	• Safe navigation, • Impact on boating traffic • Assists in permitting process, provides federal oversight.	• Private aids to navigation to mark pens; limited access to boating traffic • Certain regulations of fish tenders going back and forth • Safety navigation issues on boats
Diane Windham (NOAA)	• Role within NOAA is advisory and coordinating; • Bring aquaculture expertise and science into discussion to assist regulatory role for protected resource office that work on EFH and ESA; • Facilitate communication within agency and between agencies	• Willingness to communicate, clarity and directness; • Translate the science for policy makers, managers, public (NGOs)
Randy Lovell (CDFW)	• Ensure compliance with regulations; • Education/outreach, forming groups; • Aquaculture registration (not permit)	• Gather information we're gathering here and get it to right audience (applicants, decision makers). • Need content for outreach
Dan Swenson (USACE)	• Permit issuance: CWA Section 404 (discharge; only goes out to 3 mile limit), Rivers & Harbors Section 10 (navigation; extends all the way to continental shelf). • Coordinate with NMFS EFH consultation.	• Siting data (marine spatial planning), • Navigation (schedule, vessel type), • Infrastructure (oil and gas, underwater cables), • Fisheries data (catch, location of fishing effort), • Biological (benthic habitat, species), • Pelagic information, marine mammals
Mike Van Hoeten (USCG)	Navigation permit, impacts to navigation, AIS	• Information on vessel traffic patterns
Penny Ruvelas (NOAA)	• ESA consultation (Section 7), • Magnus Stevens EFH consultation, • MMPA • Decisions must be based on best available science; goal is to do strong defensible process that can withstand litigation; manage uncertainty • Manage uncertainty: Adaptive management, robust monitoring	• Research needs, available data from other regions: what have we learned already globally • Thoughtful, robust monitoring and adaptive management programs
Kevin Amos (NOAA)	• Aquatic animal health. • Develop policies, regulations dealing with drug use and diseases. • Potential impact to farmed and wild species.	Monitoring information (veterinary) to ensure there are not infectious diseases.

	• FDA use of therapuetants. • Assuring human health.	
Mike Rust (NOAA)	• Science coordinator (does not do regulation, but regulators are customers) • Two sides of NOAA: science and policy. Has "foot in each side," Get best available science into hands that need it. • Ensure high quality research, funding. • Support industry/ understand where improvements can be made	• Needs to know what people need for getting the best available science in a usable format for decision-making.
Alan Everson (NOAA)	Pacific Islands Aquaculture Regional Coordinator (referred to earlier talk for information on his "role")	• Programmatic regulatory structure for Federal waters that covers issues up-front, • Federal spending to support aquaculture and research.
Bryant Chesney (NOAA)	EFH consultation processes. Adverse effect determination can be rectified. Siting addressing EFH impacts.	• Proper siting criteria (bathymetry) benthic habitat. • Analysis commensurate impacts. • Appropriate monitoring plans.
Walt Wilson (NAVY)	• Encroachment	• As action agency, focuses on who will react to them (for example, invasive species—Striped Bass potential issues)

<u>Questions for panelists:</u>

- Don Kent (HSWRI): re. "regulatory streamlining" in federal waters
  - Clarification that projects are not located in federal waters for "regulatory streamlining," it's a framework that doesn't exist. If he went into state waters would need a lease, and specific statutory prohibition to issuing the lease. If he wants to get started now, the only option is federal waters or abroad
- Randy Lovell: reinforce point that regulatory decisions must not only factor in science, but also the legal challenges that may come about from gray areas in statute. Legal exposure is often as much a consideration as science and logic.
  - Response: if doing what is politically expedient, would not even have a proposed farm, but science is getting us out of that
  - Recommendations from regulators: start small and expand incrementally. Best way to reassure agencies is getting small facility out there you can actually track/prove
  - Response: does not work on small scale, where you have to pay for boat to come out there every day
  - Response from Don: plan is to start small with 4 cages, then monitor for years, then expand
- Krista Kamer: in terms of data needs, we have bottom photography, seafloor mapping program for California state waters (CA Seafloor Mapping Program). Is that the kind of data you would need with regard to bathometry and habitat data?
  - Response (Bryant Chesney): Can use combination of data sets. Helps with planning

and siting, but still need for ground verification
    - Missing connection: data exists but not aware of it from regulator side.
    - Whether or not there is data gap is case specific. ***Potential data gap***
- Corey: How much of this is legal fear?
    - Response (Dan): no fear about aquaculture projects specifically, just don't get a lot of applications; make defensible decision from reasonable information
    - Penny: litigation is reality, not fear, so know how to deal with it (use best available science, management and monitoring), which is why were using info best way we can
    - Mike: there is a definition of "best available science" and rely on that
    - Bryant: not threat of being sued as much as fitting in/ being consistent with all other projects going on
    - Randy: already case law on many other topics of ESA and EFH
    - Dan: where they get into trouble: decisions without rational. Not looking for absolute certainty, but must show defensible decision
    - James: trying to bring consistency into what is "best available science," because legally there is a lot of wiggle room.
        - Question for Bryant—is there a standard for Best Available Science used for other industries we can follow?
        - Bryant response: boils down to regulators having too little resources too many projects to review. Would like to be proactive and set stage for more streamlined consultation process
    - James is finding that in every region, so can help assemble science for them. Develop in house standards that can really advance timeline in consultation
- Russ Vetter: everything being done here is because there is not proper legislation. Are there any common accepted "best practices" for applicant to follow or for agency reference? (Not in codified legal sense)
    - Randy: struggling with that concept in PEIR. Should be something like that
- Dale: seafloor mapping info was extremely valuable
- Mark Drawbridge: SB 245 prohibits cage culture of nonnative species, native salmon. The law does not include striped bass. No specification as to origin of broodstock, selective breeding. Farms are permitted for growing striped bass in Mexico

11:15 BREAK AND REFRESHMENTS

Key element: what are the science gaps? Needs?

- **Needs:**
    - Organized/accessible usable data gathered from all sources
    - Spatial/temporal 3D data on ocean use (different ocean uses, where and how it is being used, and how uses change)
    - Samples of robust monitoring plans (gathering samples of plans used for siting and monitoring aquaculture sites around nation)
    - Framework and examples of adaptive management plans (Gathering where adaptive management plans have worked well for siting aquaculture)

- Field verification and validation of impact models for EFH (allowing access for academic and research in areas to validate models)
- Nonnative species risk assessment analysis (combo of science and going through exercise); associations of novel structures in ocean environment that could provide stepping stone for nonnatives (ex., nonnative invasive species on oil platforms that provide unique structure for them)
- Risk analysis (risk assessment is part of that)
- Interactions and risks with animals and possible changes in behavior
- Before/after/control impact (BACI); getting before and control data to have context for data collected
- Examples of good monitoring and sampling points in different regions
- Ways outside science (from other regions for ex.) may appropriately be applied as best available science/level of agreement among agencies for what is best available science
- Succinct library of information tailored to different user groups; possibly summarize/synthesize information

11:50 Workshop conclusion: RECOMMENDED ACTIONS AND NEXT STEPS

Consensus seeking exercise: How does Southern California advance marine aquaculture development? What are the recommended next steps that build on workshop discussions?

For the purposes of this workshop, consensus was defined as follows: Consensus means that all group members either fully support or can live with the recommended next step and believe that their constituents can as well. In reaching consensus, some Panel members may strongly endorse a particular proposal while others may accept it as "workable." Others may be only able to “live with it.” Still others may choose to “stand aside” by verbally noting a disagreement, yet allowing the group to reach a consensus without them. Any of these actions still constitutes consensus.

The table below illustrates 1) culminating workshop discussions, followed by 2) consensus-based recommended actions.

Science/ Needs/ Activity	**Permitting Process**
Discussion: - Priorities shown by Don: 9 research areas needed, generated by sub-group of Office of Science and Technology. Next step could be to specify details of what is needed for that plan - Complete data synthesis and implementation plan - Provide regional/CA-specific	Discussion: - Formalize interactions from interagency working group, convened by Diane, for Rose Canyon Fisheries permitting - Define/articulate roadmap or checklist for obtaining permits - Aquaculture Development Committee: focused on state agencies; made up of 6 state

input - Research that needs to be addressed needs to be put into request for proposal (RFP); link with local Sea Grant programs - Link grant research priorities to available funding	agencies, industry representatives, legislative member; could inform interagency working group - Need for one website/place to find all information we say here (virtual permit tool in the works) - Connect scientific community with funding - Interagency working group does not have formal status***; possible action item*:** get official endorsement and charter/ evolve to formal status? - Interagency working group can be forum for applicant to make presentation of information to all agencies involved; pressure to let applicant know if there are any issues right away - ***Point of Disagreement:*** whether to involve academics in working group. Involving others other than agency reps triggers requirements to open it up to all stakeholders. Suggestion: have later discussion for optimal membership in this group at later point (*see Consensus below*) - Recommend Randy and Diane talk with OPC and OST to directly fund research towards these topics; make funding available for needed science - Federal activity needs explicit instructions. Experts must filter raw data into decision. Must accept input from concerned public
Consensus: Federal Research Plan - Work to advance 9 inter-agency recommendations for aquaculture development (endorse). - Complete data synthesis and implementation plan. - Provide regional/CA-specific	**Consensus:** Advance the already established interagency working group as forum to explore offshore aquaculture generally Potential early issues for discussion - Articulate roadmap for permitting process.

input into implementation plan. - Link on the ground research priorities to available funding - Integrate data & models	- Inform/ interface with ADC (Aquaculture Development Committee) & legislative member - Link or utilize existing or emerging information sharing tools - Regularly articulate science needs / decision tools available to the science community - Help connect dots between available funds & needed science - Evolve from ad hoc to formal status - Provide early evaluation of pending permitting decisions - Learn lessons from other working groups - Discuss optimal membership - Maintain a well-constructed, transparent body, good, clear governance, considers public input **NEXT STEPS/ACTION ITEMS:** - Diane will set up next meeting/call and start the conversations based on above consensus items - Interested in soliciting feedback from this group on whether the next meeting should wait for the meeting summary (from this meeting) or not - If interested in participating, let Diane know (goes to discussing optimal membership)

1220 WORKSHOP SUMMARY AND CLOSING REMARKS 1200 LUNCH

Logistics/Next Steps: group photo, contact list of participants, meeting summary

- Contact list:
  - Separate list of names/emails will be sent around to group
  - **ACTION ITEM: let Linda know if issues sending out contact information to group**
- Meeting summary: will have it out in final form by no later than June 15
- Access to PowerPoint presentations: **ACTION ITEM: let Linda know if not comfortable with sending out PDF's of presentations. Will be made available to group**.

Closing remarks (Jerry): productive 2 days. Will incorporate advantages of aquaculture into Aquarium, general public perception.