

***Aquaculture Investment at OSU:
Opportunities for Advancing Seafood Security***

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EXECUTIVE SUMMARY

Growth in aquaculture, both nationally and globally, presents a huge opportunity for OSU. With extensive human and physical assets available to support a diverse aquaculture program, OSU is positioned to be a recognized national leader in advancing seafood security through research, development and training in sustainable seafood and aquaculture practices.

This report outlines the background information generated by an ad hoc group of over 50 OSU aquaculture-related faculty representing eight OSU Colleges, as well as agency and industry representatives. Following on a review of over 40 institutions nationally, and an internal assessment of OSU strengths and assets, it is clear that a minimal, strategic investment, could establish an organized structure to foster and build a more coordinated aquaculture research and educational enterprise – ultimately generating extensive revenues for OSU and Oregon.

Building on the basic tenets of SP4.0, an effort to institutionalize and coordinate OSU's aquaculture research, education, and outreach efforts would enable OSU to meet the following goals:

- Build a nationally recognized research and academic aquaculture program known for its innovative and diversified research approach, applied experiential education, and creative engagement with stakeholders and external partners.
- Enhance and institutionalize the collaborative aquaculture environment across OSU based on coordination, transdisciplinary research, and experiential education.
- Generate opportunities for increased funding by enabling bold programs that support scientific innovation, entrepreneurship, industry investment and engagement, and public education.

The timing for this initiative is now; major funding opportunities are currently being made available and through this process, national leaders will arise. OSU must be one of those leaders, and should be the primary leader on the west coast. State and federal government agencies are anteing up research and training dollars for aquaculture, and these are being matched by industry. OSU needs to capitalize on this momentum, build on its aquaculture strengths & assets, and in the true land grant/sea grant spirit of this University, lead in addressing the local, national, and global need for a food-secure future and a strong domestic workforce.

PREAMBLE

Aquaculture is the world's fastest growing agriculture sector, popularly considered a "Blue Revolution" with international growth ranging from 6% to 10% per year since 2000 (FAO 2018, Figure 1). Today aquaculture represents approximately 50% of global seafood consumption and more than 70% by 2050 (Costello et al. 2020). The US imports 85-95% of its seafood - broadly defined as fish, shellfish, and aquatic plants (Lester et al. 2018) and the majority of seafood imports are aquaculture products. Increasing US aquaculture production is considered an important food security strategy and a major objective in the Department of Commerce's 2018-2022 national strategic plan (DOC 2018). New federal legislation for aquaculture including AQUAA (Advancing the Quality and Understanding of American Aquaculture), is meeting with bi-partisan support in Congress. Federal and State agencies are demonstrating increased support for aquaculture as they recognize that capture fisheries alone cannot meet our country's, or the world's, demand for seafood. This has resulted in more funding for aquaculture R&D than at any other time during the past two decades.

Oregon is ideally positioned to participate in this expansion of US aquaculture. Oregon is endowed with abundant fresh and marine waters, a moderate climate, strong collaborations among researchers, fishers, farmers and processors, and a culinary culture featuring high levels of seafood consumption. The State already hosts a major commercial hatchery for production of oyster seed, and, according to industry experts, farms located in Oregon's coastal estuaries annually produce oysters valued at more than \$10

million¹. In addition, Oregon's federal and state salmonid hatcheries operate in many watersheds and produce millions of salmon and trout fingerlings at a total cost of \$28 million for restoration and recreational and commercial fisheries (ODFW 2018). Oregon's Department of Agriculture has proposed doubling the value of private sector aquaculture products to more than \$20 million (Portland Business Journal 2015).

In the early 1980's, OSU was at the forefront of aquaculture research and education as one of the few universities in the world offering a master's degree in aquaculture, combined with instruction and research by numerous tenure-track faculty in aquaculture. Over the years, as State interest shifted to capture fisheries and other natural resource issues, the aquaculture degree was eliminated, retiring aquaculture faculty were not replaced, and programs became increasingly decentralized and uncoordinated. Yet, largely through independent entrepreneurial

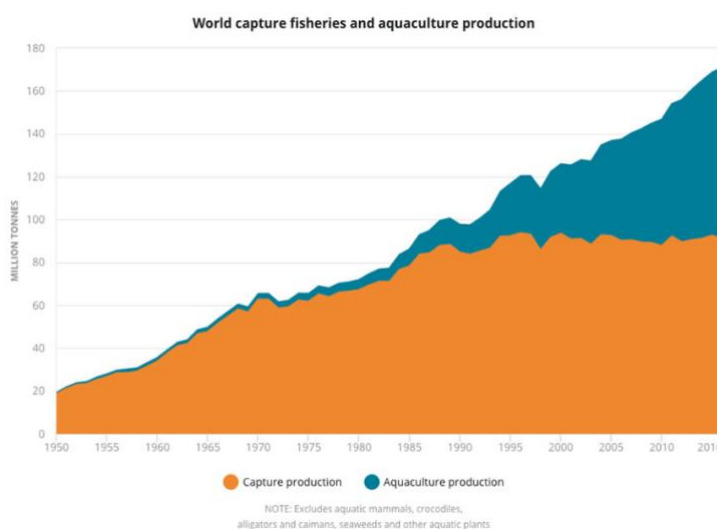


Figure 1. State of the World Fisheries and Aquaculture Production.

¹ State statistics indicate \$2.2M in farm-gate value but this represents only a subset of farms and leases (Oregon Department of Agriculture 2018)

research efforts among adjunct and tenured faculty, OSU has managed to retain a solid reputation as an aquaculture leader in research including salmonids, shellfish, tilapia, aquaculture food security, gender in aquaculture, aquarium management, and fish diseases. OSU also enjoys a strong international reputation in aquaculture, largely because of its successes in serving as headquarters for a number of federally-initiated international aquaculture programs. Beginning in 1978, OSU positioned itself as leader of a consortium focused on international fisheries and aquaculture. Subsequent grant programs (Aquaculture Collaborative Research Program (CRSP), Feed the Future Aquaculture & Fisheries CRSP, and AquaFish Innovation Lab) further developed relationships with over 200 international institutions in more than 25 countries.

A year ago, more than 50 OSU aquaculture-related faculty representing eight OSU Colleges, as well as agency and industry representatives, recognized the need to **institutionalize and coordinate OSU's aquaculture research, education, and outreach efforts**. The group formed subcommittees to evaluate OSU assets, comparators, and strategic opportunities. One of the primary outcomes of these meetings was the belief that OSU can reclaim its former status as a Blue Revolution leader in aquaculture education, research, and outreach regionally, nationally, and globally. Furthermore, with growing commercial and public-sector interest, an increasing number of students are expressing interest in aquaculture and aquaculture-related fields, indicating considerable scope for expanding aquaculture instruction at OSU. Following the successful establishment of MSI and the "Food from the Sea" planning initiative, we need to utilize the momentum and capitalize on OSU's strength & assets and the local, national, and global need for a food-secure future and a strong domestic workforce.

VISION AND GOALS

Vision

Oregon State University is a recognized leader for advancing regional, national, and international aquaculture and seafood security. Success is built on fostering collaboration within and outside the University, coordinating OSU's significant and diverse seafood, natural resource, and agriculture assets, and embracing Land Grant and Sea Grant Missions. Successful aquaculture programs are noted by their support of: 1) innovative, sustainable², adaptive, and entrepreneurial programs; 2) transdisciplinary and systems-based approaches; and, 3) integration of research, education, and engagement responsibilities. Creative programs attract significant and diversified funding, national and international students, and industry and community partners.

Goals

- Build a nationally recognized research and academic aquaculture program known for its innovative and diversified research approach, applied experiential education, and creative engagement with stakeholders and external partners.
- Enhance and institutionalize the collaborative aquaculture environment across OSU based on coordination, transdisciplinary research, and experiential education.
- Generate opportunities for increased funding by enabling bold programs that support scientific innovation, entrepreneurship, industry investment and engagement, and public education.

² *Sustainable aquaculture is defined as long term profitable aquaculture development that supports environmental and ecosystem conservation.*

STRATEGIC ANALYSIS

Strengths and Assets

The core strength of OSU as a Land Grant, Space Grant, Sun Grant, and Sea Grant College is its extraordinary range of physical and human capital assets that support wise use and conservation of natural resources. For aquaculture, these assets are represented by a) OSU's collaborative faculty, b) diverse campuses, facilities, geographies, disciplines, stakeholders, and c) a broad network of experiment stations and extension centers (Figure 2). These assets support seafood and agricultural industries in order to develop and secure safe, nutritious, and sustainable food production in a rapidly changing world.

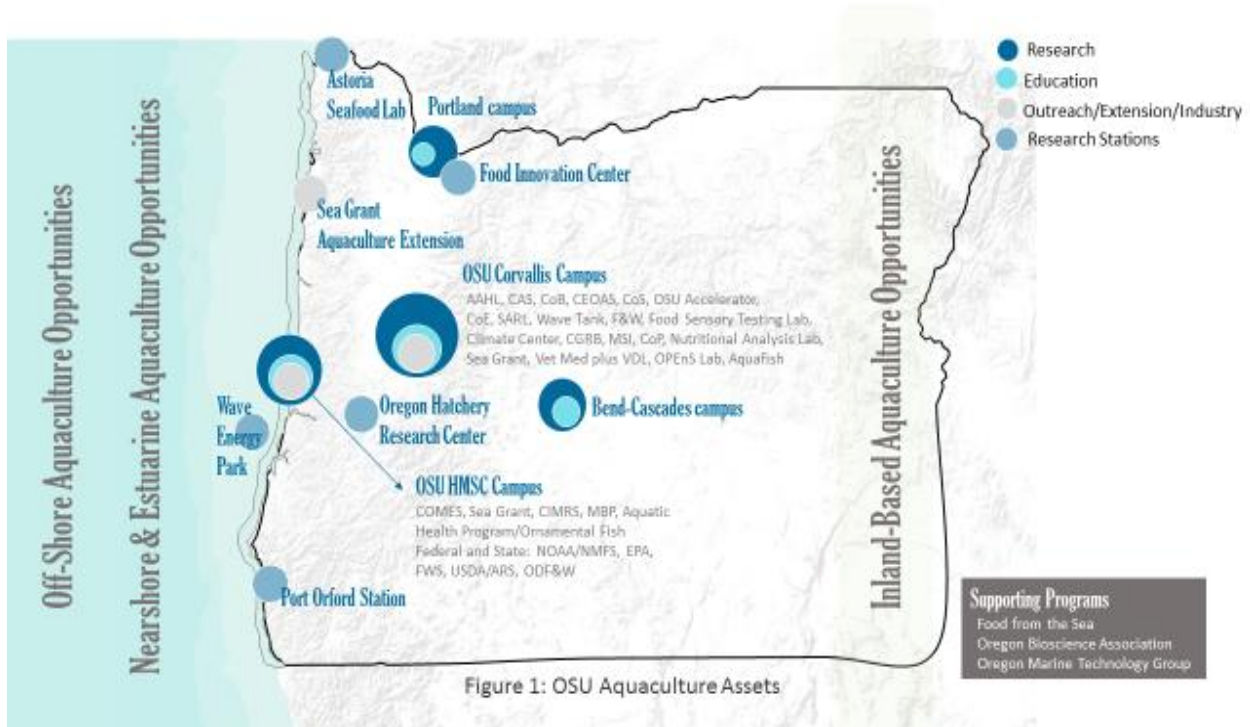


Fig. 2: OSU and its extensive network of aquaculture relevant assets

This extensive network positions OSU as a potential powerhouse for aquaculture research and education across a broad landscape that includes offshore, nearshore, estuarine, and freshwater/terrestrial environments. The HMSC, with its nationally recognized marine campus featuring co-located federal and state agencies, functions as a geographic and intellectual hub located on or near a variety of aquaculture and fishery seascapes and landscapes. Other significant OSU facility assets include: Aquatic Animal Health Laboratory (Salmon Disease Lab), Sinnhauber Aquatic Research Laboratory, Oregon Hatchery Research Laboratory, and Fish Performance and Genetics Laboratory.

Faculty				
Undergraduate Students / Graduate Students				
Programs & Research	Marine and fisheries biology	Industries	Communities	Agencies
	Ecology			
	Aquaculture			
	Aquatic animal Health			
	Policy/law			
	Resource management			
	Seafood science & safety			
	Economics			
	Engineering			
	Public Health			
	Marketing and Buisness			
	Social Science			
Consumer Science				
Opportunities for interdisciplinary education, research, workforce development, and distance learning				

These considerable strengths and assets can be employed and integrated to support OSU as a global leader and an integrative interdisciplinary Center of Excellence for aquaculture programs. This includes building on OSU’s existing educational programs to develop an aquaculture and seafood industry workforce designed to meet 21st century needs and opportunities (Fig. 3). Development of future sustainable aquaculture industries will require innovative research to improve efficiency and profitability, conserve natural resources including valuable water and energy inputs, and support interdisciplinary and experiential education programs that lead to development of a skilled and adaptable workforce.

Fig. 3. OSU has a large and diverse faculty with an abundance of programs and research that, combined with partnerships with industry, communities, and agencies, educate the 21st century workforce and benefit its stakeholders.

National Comparators

Forty-one academic institutions were reviewed using rapid appraisal techniques and scoring systems to evaluate aquaculture research, extension and education programs. The results demonstrated that:

- 1) Eleven institutions received a high overall score based on their rank in all three areas (teaching, education, and extension; Figure 4).
- 2) Most of the high-ranking aquaculture institutions were based in the eastern and southern United States.
- 3) The high-ranking aquaculture programs were mostly centered around regional industry aquaculture activities.

While seven programs in the western states received a ranking of medium or higher, the three programs that were the most notable regional comparators to OSU were the University of Hawai’i Hilo, University of California Davis, and University of Idaho. Of these programs, including OSU, all four ranked high in research, none of the four ranked high in teaching (only UH Hilo and UI offer undergraduate minors in aquaculture) and only UH Hilo ranked high in extension, though both UI and UC Davis have designated aquaculture extension personnel. It is also notable that UC Davis and UI have research programs largely focused on freshwater aquaculture, UH Hilo is predominantly focused on marine aquaculture, while OSU has research activities in both freshwater and marine aquaculture.

A subset of institutions that presented either regional competition or potential models applicable to OSU were

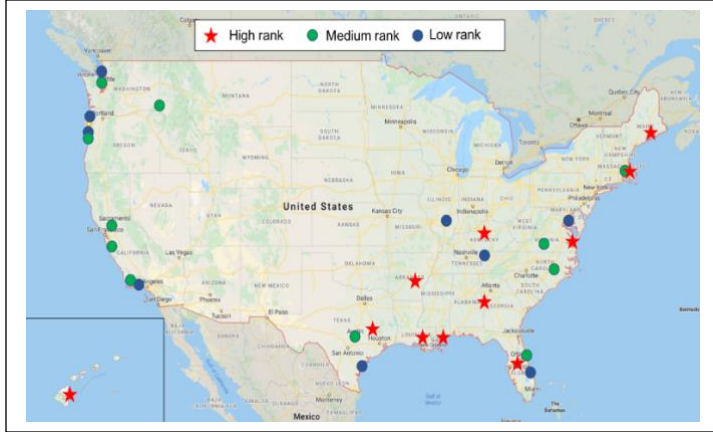


Figure 4. National Aquaculture Comparators

evaluated in more depth. There were several ‘Centers’ and ‘Institutes’ that allowed for cross-disciplinary research among multiple departments or disciplines. University of Maine houses the Aquaculture Research Institute (ARI) which focuses on a wide variety of aquaculture activities (primarily marine) and works across a wide range of disciplines. The University of Maine ARI is multi-campus and focuses on aquaculture research as well as job development for the state. Similarly, the University of Idaho houses an ‘Aquaculture Research Institute’ (coincidentally named) which is also

multidisciplinary and multi-campus. The UI ARI focuses on trout and freshwater aquaculture and is primarily a research institution. Both UI and U Maine are notable in that they are tightly coupled with industry through formalized agreements.

The results of our rapid assessment evaluation indicate an opportunity for strong leadership in the area of aquaculture research, education, and extension on the US west coast. OSU is well-positioned for this role given its substantial assets. Presently, however, OSU does not stand out as a high-ranking institution largely because:

- OSU has a high number of faculty conducting aquaculture-related research, but it currently lacks a cohesive and organized aquaculture research structure and has less than 2.0 FTE of tenured or TTF faculty in aquaculture.
- OSU is a Land, Space, Sun, and Sea Grant institution, but it presently does not have a robust aquaculture extension program;
- OSU offers several courses in aquaculture and aquaculture-related studies, but it does not offer a degree or certificate program in this field.

Strategic Opportunities

The diversity, creativity, and commitment of Oregon State University to support sustainable agriculture and natural resource industries and communities, combined with the rich confluence of University organizations, federal/state agencies, and private industries, creates unique potential for Oregon State to advance aquaculture research, education, and engagement. Key opportunities include:

Catalyzing OSU Assets across Diverse Environmental Systems: OSU is one of the few universities on the West coast or nationally to be endowed with an abundance and quality of existing -- and potential -- human and physical aquaculture assets. These assets include faculty that operate programs at every possible geographic scale including small communities, the Oregon coast, West coast, the nation, and the world. OSU interdisciplinary programs (e.g., CIMRS, COMES, MSI) provide synergistic and creative opportunities to develop aquaculture programs that build on the foundation of existing and newly forming “networks” of OSU institutions and aquaculture industries.

Transdisciplinary and Food Systems-Based Scholarship and Education: Few institutions in the United States or globally employ a comprehensive and “food systems” approach that integrate ecosystems, production, marketing, and policy research consistent with the challenges inherent in 21st Century aquaculture. OSU is ideally positioned to integrate a broad range of disciplines in a systems approach to address challenges in both research and education. Developing an aquaculture transdisciplinary educational program would complement broad-based, “learning models” at OSU including the new MSI degree program, and would be strongly supportive of SP4.0 goals. It would also build off the existing agriculture, fisheries, and seafood education infrastructure to develop a seafood industry workforce designed for the 21st century. Potential new courses and experiential-based curriculum would support certificate programs and degrees for undergraduate and graduate students as well as working professionals. The range of possible courses and curricula would create transdisciplinary educational opportunities integrating, for example, fish health, genetics, policy, management, bio- and ecosystem modelling, engineering, and seafood development and marketing.

Creative Community Engagement: OSU has a well-deserved reputation for authentic stakeholder engagement and collaboration. But like much of the U.S., Oregon has a variety of attitudes about aquaculture due to a lack of fundamental knowledge, historic policy issues associated with wild and hatchery fish, and challenges associated with using public resources. Aquaculture provides business and job opportunities in rural communities but requires creative engagement and innovative strategies that enhance ecosystem services and efficiently utilize water and energy resources. Developing aquaculture strategies consistent with the state’s sustainable and “green image”, while also promoting diversity in the workforce will be vital. It will also be vital to develop a broad range of partnerships with industry, community colleges, and other educational institutions.

Sustainable Leveraging of External Drivers and Financial Support: The federal government is making major investments in supporting domestic aquaculture production. For example, in 2019 NOAA allocated \$16 M for aquaculture research through their national Sea Grant program. In Newport, USDA-ARS is now investing in a \$2.2M (annual budget) shellfish breeding innovation and ecology center at HMSC that is mutually leveraging significant opportunities for cooperative research and facility support with OSU scientists. The state agency Oregon Business has recently invested almost \$500K in a major grant to an industry/state agency/OSU coalition to support aquaculture investment in the state. Large seafood industry players, including Oregon-based companies such as Pacific Seafood are undertaking major aquaculture investments in the Pacific Northwest. In addition, the Oregon legislature has developed new initiatives to support shellfish research, production, and management, while Oregon’s federal delegation has expressed strong interest in supporting sustainable aquaculture development. This confluence of support by government and private industry provides a unique opportunity to develop bold initiatives that advance OSU’s engagement in aquaculture research, education, and outreach.

SUMMARY OF STATUS AND FUTURE STRATEGIES

OSU has had an uneven institutional history in supporting aquaculture research, education, and outreach. Nevertheless, OSU has retained a strong reputation as an aquaculture leader through decentralized entrepreneurial research efforts, including collaborative programs with federal and state partners.

Today, aquaculture is the fastest growing animal protein industry in the world and is considered a critical industry for achieving global food security in the 21st century. The U.S. government and national and international companies are substantially increasing investments in aquaculture.

OSU is well positioned to take advantage of these opportunities given its considerable assets, an energized and committed faculty, and its Land, Space, Sun and Sea Grant missions. However, taking full advantage of these

opportunities requires that OSU develop a focused effort consistent with its strengths and comparative advantage. Any focus, however, must seamlessly integrate its core responsibilities in research, education, and engagement.

The following strategies were selected as key foci to achieve the vision and goals.

Strategy I. Catalyze Sustainable Aquaculture: Creatively develop and support adaptable and sustainable aquaculture practices, industries, and communities consistent with addressing regional, national, and international food security in the face of climate change. Develop innovative and profitable aquaculture practices that conserve natural resources including water and energy while complementing and integrating with other agricultural and natural resource industries.

Strategy II. Develop Systems-Based Aquaculture: OSU's comparative strength is its existing (and potential) aquaculture and seafood assets, a diverse and collaborative faculty, and a strong institutional backbone of agricultural and natural resource-based campuses, programs, stations, and extension offices. This rich institutional diversity reflects Oregon's ecologically diverse working seascapes and landscapes. This diversity is a comparative advantage that both allows, and requires, that OSU take a comprehensive "food-systems" based approach in addressing various aquaculture opportunities across multiple species, systems, landscapes, and supply chains.

Strategy III. Modernize Education Programs: Design new undergraduate and graduate level aquaculture certificate and degree programs. Develop certificate opportunities to train students in approaches relevant to US domestic and international markets; this includes utilizing Ecampus to engage students no matter where they live, plus on-site training intensives at locations like Hatfield Marine Science Center, Oregon Hatchery Research Center, and OSU Seafood Lab. Certificates would lay the foundation for a broad range of individuals to enter the workforce and programs would include required courses as well as separate tracks depending on student interest including business, production, policy, sustainability/conservation, and research. Degree programs would provide more specialized and deeper training for future industry professionals.

Strategy IV. Create an Aquaculture Innovation Center: An Aquaculture Innovation Center would promote aquaculture research, education, engagement, and investment. Like many innovation centers it would be supported by public-private partnerships and function as a strategic nexus and convener. It would facilitate student training and public outreach, catalyze industry investment, and function as a business incubator and innovation "park".

ALTERNATIVE ORGANIZATIONAL MODELS

In light of the opportunities outlined above, the university can follow several different pathways. They range from continuing a "business as usual" approach (independent, entrepreneurial PIs pursuing individual research programs), to development of a coordinated Aquaculture Research, Education and Outreach Program approach. For the latter, there are several possible organizational models:

1. Leadership
 - a. Leadership by council – council, with rotating chair, made up of representatives of unit partners (e.g. each college/department/unit). Funding provided by unit partners through contribution into a general fund. Further support sought through external funds. Council determines how resources are distributed/prioritized.
 - b. Director/coordinator position (Center model) – resources initially from OSU centrally (e.g., Provost, RO) with potential for additional support from partner units (e.g., Colleges,

Graduate School, MSI). As above, the goal is for development of strong sustained funding through external grants, government and industry support, and tuition generated.

2. Program Home

- a. Directorate sits within existing academic program or research unit with experience serving as coordinating unit (e.g., COMES, MSI, department, college). This approach provides opportunity for academic program development support more than the strict research-based models.
- b. Split goals/directives – separate research and academic leadership. Research coordination could follow one of the models above, while the academic programming development could be housed within an academic unit or MSI.

Note – All options could (should) also have some advisory board structure.

OSU INVESTMENT REQUEST

To achieve these goals, we request support and modest resources from Oregon State. We are well aware of the financial constraints the University is operating under given the COVID-19 pandemic and its economic outfall. However, we believe that with modest investment by Oregon State, the aquaculture enterprise of OSU can become a revenue generator through a significant strengthening of our aquaculture research portfolio, development of undergraduate and graduate student academic programs, and expansion of our extension and engagement efforts. It could serve as an example of **Building Back Better** through creating efficiencies and opportunities across the University.

We propose an initial two-year “Center Model” for investment by the University, with specific outcomes to be reviewed as metrics for assessing continued support beyond the initial two years. In this staged effort, we anticipate initial focus on:

Year 1

- i) Expanding and strengthening OSU’s aquaculture research portfolio through coordination and development of larger, collaborative proposals;
- ii) Development of marketing materials (e.g., website, virtual tours of OSU aquaculture assets);
- iii) Survey of industry workforce and research needs, coupled with market analysis of student interests;
- iv) Establishment of an aquaculture speakers forum to begin strengthening the OSU aquaculture network.

Year 2

- i) Continue to expand the research portfolio
- ii) Team with the Marine Studies Initiative and partner departments and colleges to begin to build courses, certificates and possibly major programs in aquaculture.

To achieve this we propose that we follow the stronger “Center model”, and therefore request funding for a faculty-level Director (or equivalent) at 0.50 FTE (i.e., 6 mos. faculty salary buy-out) to provide the leadership and coordinating focus to meet the above efforts, as well as a modest budget to support the initial activities (\$25K/yr).

The ultimate target (after 3-4 years) will be for strong external funding to support a growing Center of Excellence for Aquaculture, as well as expanded educational programs attracting tuition-paying students.

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