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# Taking a close-up look at land-based recirculating IMTA system development at Florida's HBOI-FAU



by Paul S. Wills

FT. PIERCE, FL – Harbor Branch Oceanographic Institute at Florida Atlantic University (HBOI-FAU) has recently embarked on a two-year project designed to advance the technology available for sustainable land-based aquaculture by incorporating the concept of Integrated Multi-Trophic Aquaculture (IMTA) into a recirculating aquaculture system (RAS).

The development of integrated multi-trophic aquaculture (IMTA) will be a key tool for enhancing the sustainability of aquaculture products<sup>1</sup>.

IMTA is defined as "... the practice which combines, in the appropriate proportions, the cultivation of fed aquaculture species (e.g., finfish and shrimp) with organic extractive aquaculture species (e.g., mollusks and macroalgae) ..."

IMTA is distinguished from traditional polyculture in that the individual species being cultured do not need to share the same living space, but rather requires the sharing or transport of nutrients between "fed" and "extractive species."<sup>3,1</sup>

In this model of IMTA, "extractive species" provide biomitigating functions for the waste generated by the "fed species," thereby reducing nutrients in water destined either for discharge or reuse.

This is in contrast to monoculture systems that discharge directly into receiving systems using dilution for pollution mitigation.

The leveling off of commercial fisheries catch in recent decades, in the face of growing seafood demand, will continue to fuel the need for increased aquaculture output<sup>4</sup>.

The Global Aquaculture Alliance has recently  
*Continued on next page*

Dennis Hanisak, PhD, research professor at HBOI-FAU harvests seaweed from the HBOI-IMTA system.

Julia Scarpa/HBOI-FAU photo

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projected the need for a doubling of aquaculture output in the next decade to meet global seafood product demand (W. Stevens, pers. comm.).

Among the varied aquaculture systems used, tank-based RAS provide a level of control of discharge unavailable for many aquaculture systems.

RAS's tend to require less water and have higher output per unit area, but have high energy requirements.

Much effort worldwide is being directed to maximizing efficiency and productivity of RAS designs.

They are recognized by "watchdog" groups to have a high likelihood for environmental sustainability<sup>5</sup>.

The discharge of the water from a RAS can be seen as wasting a valuable resource, namely water carrying a high nutrient load.

It would be better to consider the "waste" a resource, as in an IMTA system.

The logical next step in RAS design is the adaptation of an IMTA scheme whereby the nutritive waste stream is used to produce additional crops rather than being discharged (Fig. 1).

The IMTA concept in a closed recirculating design would use extractive and assimilative processes (e.g., extraction of particulate waste by filter feeders, and assimilation of nitrogenous and phosphorus wastes by plants) to enhance the crop diversity of a land-based farm.

Typical land-based IMTA systems being proposed use a single-loop serial flow regime whereby all of the culture water flows through each of the culture cells (fed and assimilative) with ammonia reduction ultimately accomplished by assimilative culture of plants (either phytoplankton or macrophytes, Fig. 1).

This design presents some potential difficulties for integration.

For instance, waste water with high ammonia concentrations is delivered to an extractive culture component likely reducing productivity.

Solids from the extractive culture move through the assimilative culture component causing fouling, plus full water flow potentially reduces assimilative efficiency by the plants.

A new concept in closed system IMTA being proposed by researchers at HBOI-FAU (the HBOI-IMTA system) uses a centralized filtration system that delivers controlled volumes of selected pretreated waste streams to each system component (Fig. 2), potentially resolving water quality and flow distribution issues related to the traditional closed system IMTA schema.

The decision of which fed aquaculture species, filter feeding species, and plant species will be critical to the successful integration for a practical IMTA farming system, however, a wide variety of fed and extractive species combinations is conceivable.

See HBOI REPORT, next page



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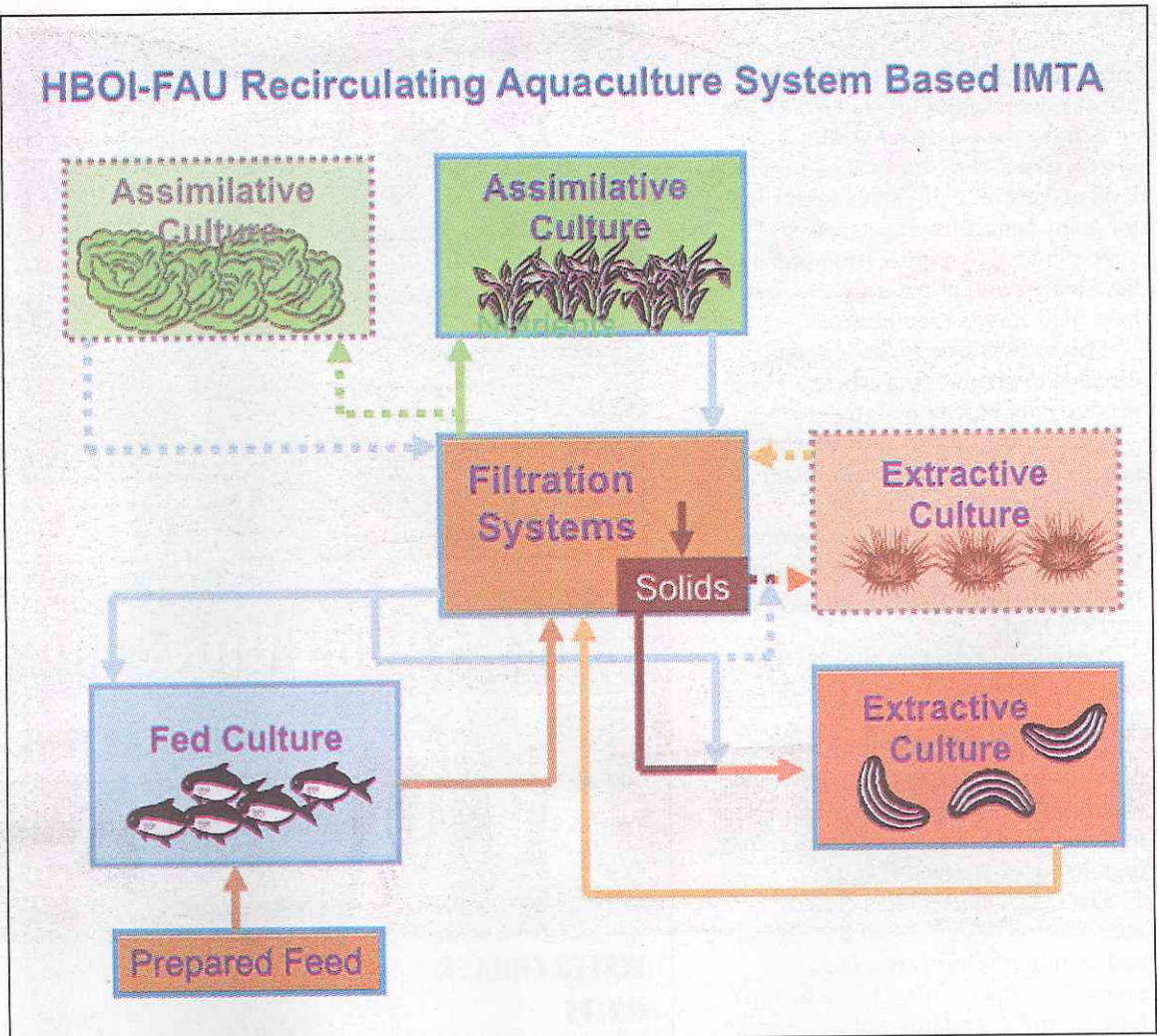
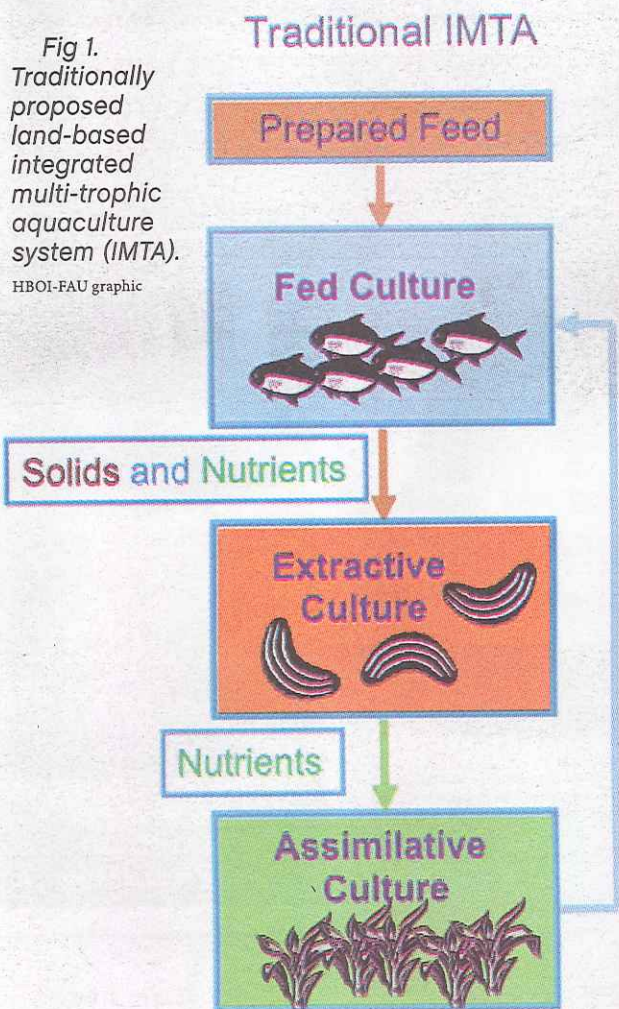
# HBOI Report

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There are examples of the application of IMTA to open-ocean and extensive pond-based systems, but – due to the complexity of applying the IMTA concept – there are few examples of fully integrated, land-based, closed recirculating systems of any design<sup>1,5</sup>.

HBOI-FAU has a ready resource of scientists, researchers and engineers who possess the breadth of knowledge and experience with each of the proposed system components to complete an HBOI-IMTA design system with a high likelihood for success in development and integration.

The team has designed and constructed a prototype system to assess engineering and biological challenges for a system



**Fig. 2.** Components of the proposed HBOI land-based integrated multi-trophic aquaculture system (HBOI-IMTA).

HBOI-FAU graphic

capable of having various fed, assimilative, and extractive components added to it in a “plug-and-play” manner.

Over the next year the team will:

- Characterize solid wastes (sludge) and filtered waste streams being produced by a fed fish culture module attached to the prototype HBOI-IMTA system;
- Determine and refine methods for moving various waste streams between the central

filtration system and each of the culture modules under operational conditions; and

- Develop models of nutrient cycling within the HBOI-IMTA prototype for predictive modeling and scaled-up system design.

This project is fully funded by the Florida Aquaculture Specialty License Plate Program. /ffn/

Paul S. Wills, PhD, is associate research professor at HBOI-FAU.

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Here's a look at the HBOI-IMTA's central filtration systems with shrimp and fish tanks in the background.  
 Paul Wills/HBOI-FAU photo

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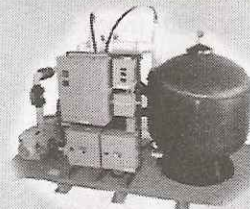
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