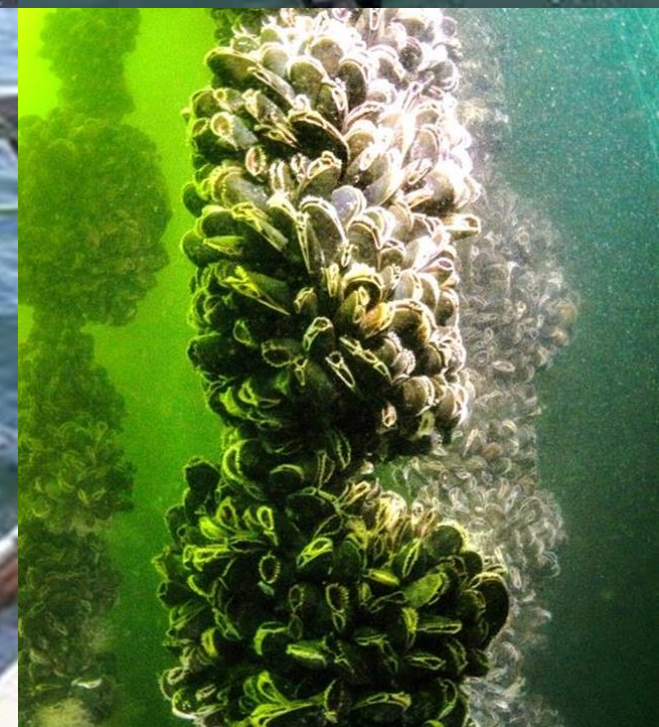




Development of mariculture training modules for a Maine Maritime Academy (MMA) Center for Professional Mariner Development (CPMD) Mariculture Certificate

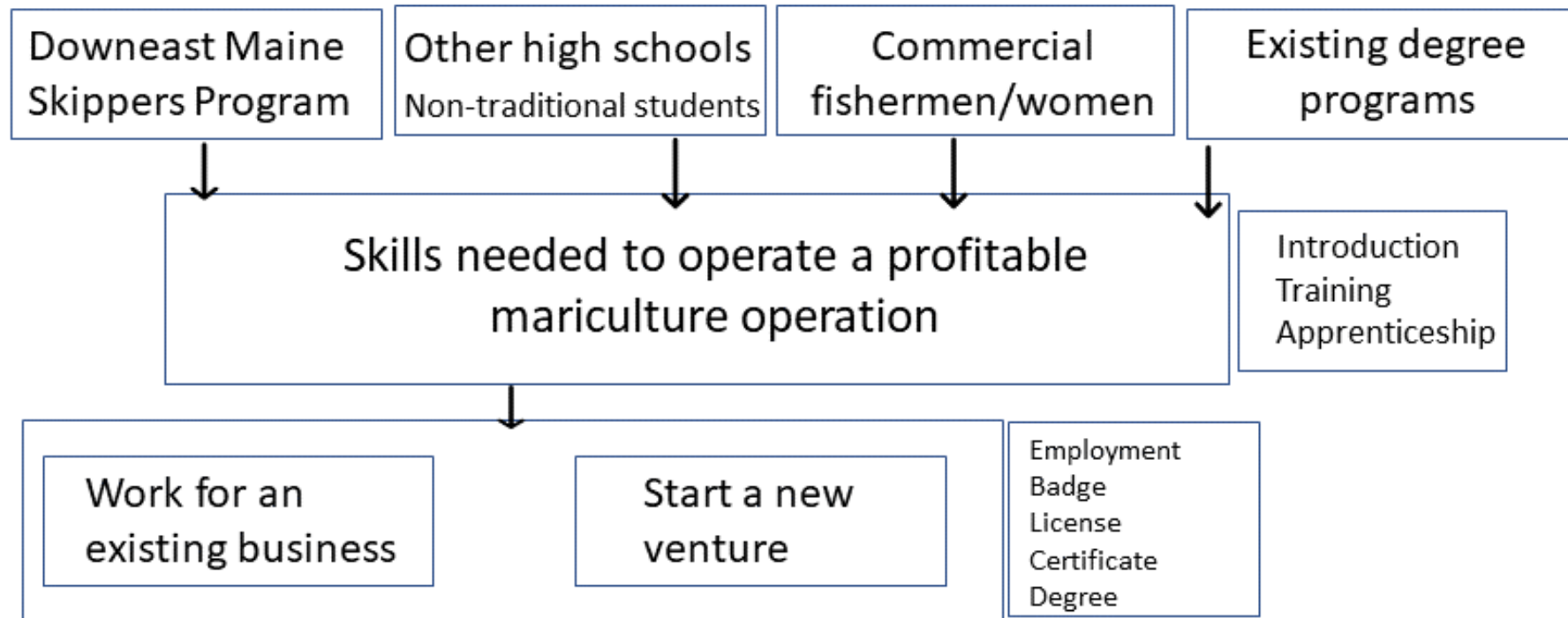
Carter Newell, Ph.D, Adjunct Professor, MMA

Tim Achorn, Director, MMA CPMD





The program is a Community College Level series of **8 modules and an apprenticeship** which equal **1 year of community college** focused on knowledge and skill development for mariculture workers or start-ups at CPMD in Bucksport





Program is developed with flexibility around the student

- Can take one module at a time (or 2 per semester or 4 per year)
- Can do the whole program (8 modules and apprenticeship over 2 years)
- Blended courses 2 nights a week part online/part live zoom; hands-on activities on Saturdays
- Articulation agreement and enrollment agreement with WCCC
- Students can continue on to get Associates Degree through the Maine Community College System



Modules and content : **online, zoom, in-person**

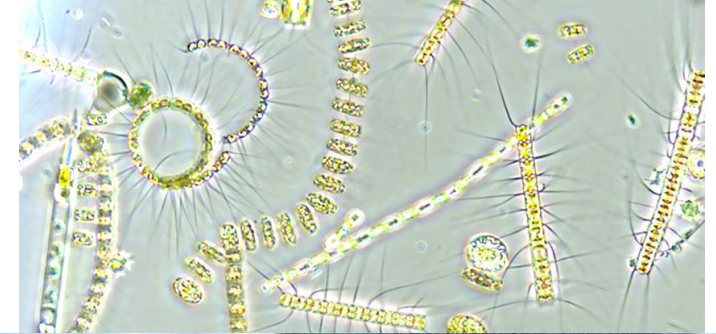
Examples of some of the skills developed

- Each module has a **glossary with definitions** of key terms used in the field
- Some basic computer and math skills are also taught
- Water sampling, CTD and current meter use and analysis of data
- Boat handling, seamanship, navigation, basic outboard, diesel and hydraulic systems troubleshooting, anchoring, maintenance
- Business accounting, Quickbooks, business plan, HACCP, Vibrio, USCG safety, Red tide, Water quality classification, Site selection, LPA and lease applications, Key knots
- Hatchery/seed collection, nursery, grow-out, processing methods, vessels and machinery



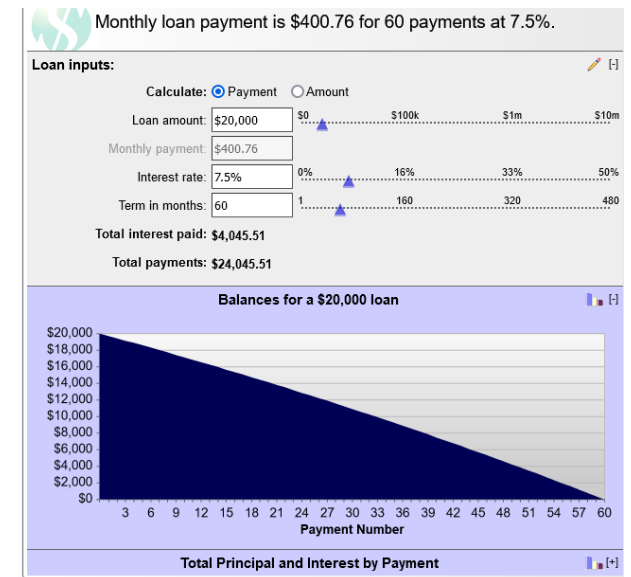
Module 1 : Introduction

- Sustainable Maine Mariculture
 - World aquaculture – species and methods
 - New England and Maine – wild fisheries and aquaculture candidates, markets
 - Species life cycles – hatcheries and seed collection
 - Nurseries – methods by species
 - Grow-out – methods by species
 - Mooring systems
 - Processing and sale – methods by species
 - Environmental interactions and sustainability
 - Elements of a successful mariculture business
 - General species biology – growth drivers, environmental requirements
 - General oceanography – currents, waves, sediments, primary production
 - Site selection introduction
 - General husbandry methods
 - Coordinate with MAIC/SMCC/WCCC summer site visits to farms / alternately visit to hatchery, mussel, oyster, scallop, kelp farms
- 5 DAYS FIELD TRIPS



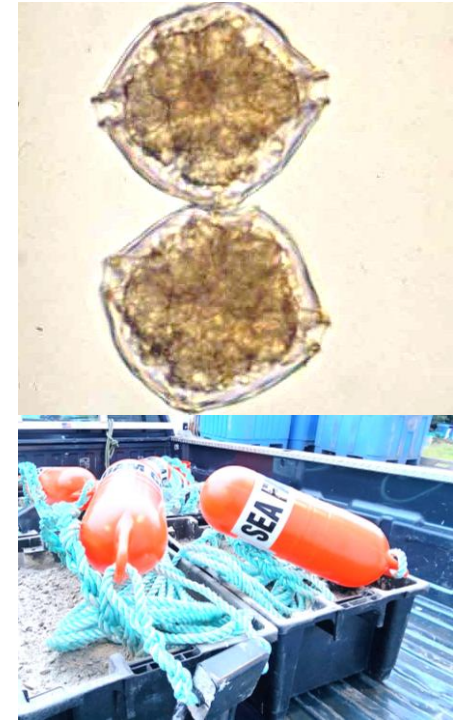
Module 2: Fundamentals of mariculture business

- Why do you want to form a business or work at an existing business?
- Business entities: sole proprietorship, LLC, S-Corporation, C-Corporation
- LLC operating agreement LAB:WRITE AN OPERATING AGREEMENT FOR LLC
- Corporation By-Laws
- Business accounting: Profit and Loss, Chart of Accounts, Balance Sheet, Cash Flow
- Accrual vs cash system
- EBITA vs profit and loss
- Start-up costs, raising capital, bootstrapping
- Business debt and amortization schedule
- Some notes about taxes
- How to deal with farm inventory
- General ledger: what was done before computers (LAB)
- Training in Quickbooks Online : entering customers, invoicing, receive payments, AP, bank deposits, generating reports (2 DAYS COMPUTER LAB)
- Writing a business plan: assumptions, cash flow projections, business model (3 DAYS WORKSHOP/COMPUTER LAB)
- Elevator pitch
- Business resources in Maine (CEI, SBDC, DECD, MAIC, MAA, GOMRI, ISLAND INSTITUTE, MTI, BANKS, DEPT OF AG) VISITING SPEAKERS



Module 3: Regulations and permits for Mariculture: what, how and why

- Maine aquaculture lease regulations: LPA, Experimental, Standard Lease
- Examples of applications, how to do your own
- Fees and permits required for leases
- HACCP plans and **HACCP certification** – write your own HACCP plan (FIELD TRIP PEMAQUID MUSSEL FARMS BUCKSPORT SHELLFISH SHIPPER)
- LAB: WRITE YOUR OWN HACCP PLAN
- Hazards, Critical Control Points, Preventative Measures
- Bacterial classification of growing areas: ISSC. Water samples, MPN, indicator organisms, shoreline survey, DMR public health division, closures
- Red tide: species, seasonality, PSP, DSP, ASP. Testing methods, closures.
FIELD TRIP BIGELOW LABORATORIES
- Harvesters and Dealer's Licenses and requirements, Shellfish shipper, shucker-packer
- Vibrio species hazards, control plans, requirements, **Vibrio certification**
- Vessel documentation, registration, trailers
- USCG requirements for vessel safety
- Insurance requirements on vessels for employees (P and I)
- Refrigerated truck licenses, insurance and requirements
- Employee workmens compensation, payroll withholding, other requirements (GUEST SPEAKER)
- Vessel mooring permit (from local harbormaster)

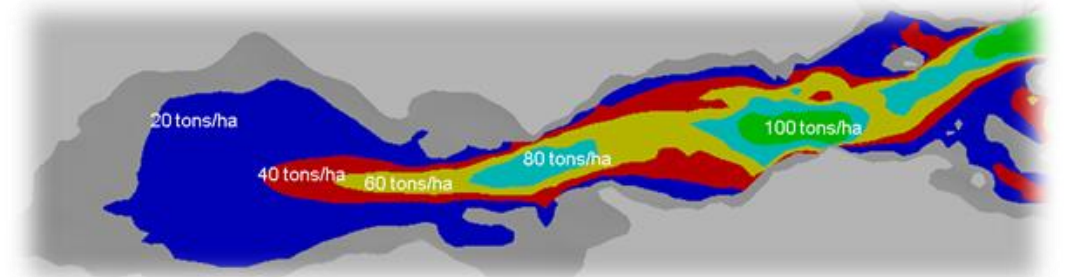


Module 4: Site selection for a mariculture lease



- Maine DMR aquaculture lease laws, record, requirements
- Existing aquaculture lease hearing records, applications, decisions
- Existing shellfish, finfish, sea vegetable leases in Maine: LPA, Experimental, Standard
- Species requirements: mussels, oysters, clams, scallops, kelp
- Water quality classifications of potential growing areas, red tide history (FIELD TRIP DMR LAMOINE LAB)
- Logistical considerations: ports, access, seasonal (ice)
- Type of mariculture and requirements: species, surface/bottom, water depth
- Sediment type and anchoring
- Social license (GUEST SPEAKER)
- Physical oceanography of the site: waves, currents, depth, temperature, salinity, stratification
- Biological oceanography of the site: primary production, food concentration and quality, presence of pests and predators.
- Growth models and results for business plan (time to market, production capacity)
- Field data collection: water samples (TPM, POM, PIM) chl a fluorescence, CTD cast, 48 hour water velocity
- Multiple species (polyculture)

2 FIELD TRIPS, 2 WATER QUALITY LABS





Module 5. Small boat handling and seamanship



- Types of vessels: rowboats, skiffs with outboards, inboard diesels, barges (outboards, inboards, hydraulic)
- Knots: square, bowline, taut line hitch, double sheet bend, clove hitch, splicing, using a cleat WORKSHOP
- Operations: rowing, stern tiller outboard, center console outboard, inboard with rudder, barges WATERFRONT
- Docking: pulling in, pulling out, effect of wind and tides (all vessels above) MMA WATERFRONT
- Navigation and safety: USCG regulations, Maine Boating Laws and responsibilities
- Rules of the road
- Using map and compass
- Cold water survival and fire safety ONLINE CPMD MMA WATERFRONT
- Principles of operation: gas and diesel engines Maintenance: gas and diesel engines (air, hydraulic, oil, gas, diesel, fuel filters). MMA LAB
- Troubleshooting: skiff outboards, diesel engines
- Includes **4 days of hands on boat handling** on some of MMA's waterfront fleet on vessels of various sizes
- Setting and hauling anchors and mooring systems
- Operations with a diver
- Towing a trailer, taking boat on and off trailers, maintaining trailer bearings (MMA WATERFRONT)

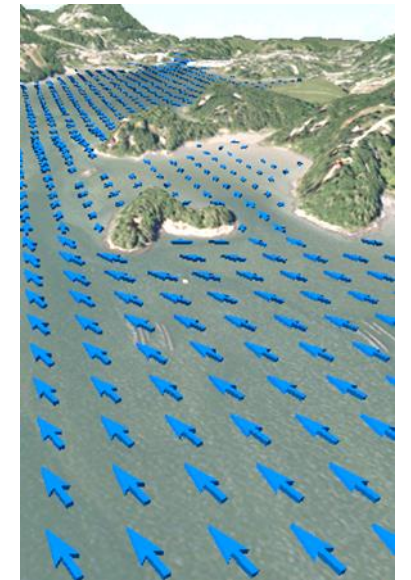
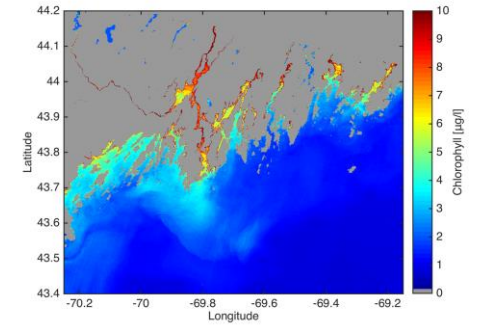
Module 6 Biology and ecology of Mariculture Species

- Basic anatomy (external and internal) of oysters, mussels, clams, scallops, kelp: LAB
 - Live cycle (reproduction, spawning, larval development, settlement, seed collection, hatcheries) FIELD TRIP
 - Bivalves: live and detrital food (food quality), scope for growth (MMA FLOW CYTOMETER, FILTER FEEDING VIDEOS)
 - Kelp: photosynthesis, light and nutrients
 - Growth and physiology (feeding, absorption, respiration, shell and tissue growth, ecophysiology)
 - Growth drivers and growth models (site, husbandry and season specific factors affecting growth and yield)
- COMPUTER LAB
- Diseases, pest and predators, cultivation strategies to minimize effects
 - Ecological role of each species
 - Environmental interactions with farmed species under a mariculture setting
 - Environmental optima for growth of each species: food, temperature, salinity, light, nutrients, water flow
 - Differences in environmental conditions: surface vs bottom culture
 - Environmental productive capacity, carrying capacity, holding capacity (COMPUTER LAB)



Module 7 Basics of Oceanography for Mariculture

- What is oceanography: physical, chemical, biological and geological oceanography
- Water flow: tides, tidal currents, waves LAB WAVE MODELS/FETCH, FLOW MODELS
- CRUISE (2): PUT OUT AND RETRIEVE CURRENT METER, DOWNLOAD AND ANALYZE DATA FROM 2 CONTRASTING SITES
- Supply and demand: role of water velocity in farm yield/production capacity LAB: PRODUCTION CAPACITY EXERCISES USING HIGH SCHOOL MATH, SIMULATION MODELS SESTON AND NUTRENT DEPLETION WITHIN A FARM (COMPUTER LAB)
- Concept of water residence time and examples
- Boundary layer flow and aquaculture structure hydrodynamics simplified (LAB)
- Chemical oceanography: light and light penetration, nutrients and nutrient regeneration, water temperature, salinity and stratification, chl a turbidity organic carbon and nitrogen (CRUISE, WATER QUALITY LAB)
- Geological oceanography: sediments and bottom culture, anchoring, methods for determining bottom type (GRAB, DIVER, POLE, ACOUSTIC: CRUISE)
- Biological oceanography: primary production models, sampling (FLOW CYTOMETER LAB MMA), food webs, competitors COMPUTER LAB: SATELLITE IMAGERY
- LOBO Buoy Data: 5 year data set of growth drivers (LAB: CONTRAST SITES FOR MUSSEL/SCALLOP/OYSTER/KELP FARM)



Module 8: Vessels, machinery and husbandry from oysters, mussels, scallops and kelp

- Seasonal activities (monthly) for growing and harvesting and harvesting
- Hatchery and nursery (FIELD TRIP SHELLFISH HATCHERY, KELP HATCHERY)
- Upwellers (oysters): grading, design, operation (FIELD TRIP OYSTER NURSERY)
- Seed collection (scallops, mussels): timing, location, mooring systems, gear
- Counting sizing and grading seed (LAB), density and biomass control on farm
- Nursery: scallops, mussels, oysters: gear and operations (LAB: GEAR CONSTRUCTION)
- Layout and installation of mooring system (LAB)
- Grow-out: longlines (scallops, oysters, mussels, kelp); construction and maintenance of longlines (FIELD TRIP SCALLOP, OYSTER); rafts (FIELD TRIP MUSSEL RAFTS)
- Fouling and predator control strategies: husbandry, gear, timing
- Basic hydraulic motor theory: motor cc/HP, pump (on vessel or on raft), system (pressure relief valves, flow control, RPM, maintenance (GUEST SPEAKER, LAB)
- Oyster grading machinery: quick tube sorter
- Mechanized handling of oystergro cages (FIELD TRIP OR VIDEO)
- Building and operating a drag and winch (LAB)
- Skiff with davit and winch for general operations
- Mussel processing line at sea, bagging at shipping (FIELD TRIP MUMBLES, PMF BUCKSPORT)
- Scallop gear for ear hanging, washing bags, seed sorting (FIELD TRIP OR VIDEOS)
- Harvesting and processing kelp (vessels, methods) FIELD TRIP



Module 9: Apprenticeship

- In order to complete the certificate, students will have to obtain an apprenticeship working on a Maine seafarm for a period of 400 hours (like the aquaculture pioneers program)
- Apprenticeships could be coordinated with SMCC, WCCC, MAIC, GOMRI and MAA
- Ideally this would involve at least 1 day harvesting kelp, 1 day on an oyster nursery, 1 day harvesting oysters, 1 day in a shellfish shippers plant, 1 day harvesting mussels, one day on a scallop farm, one day in a shellfish or seaweed hatchery, one day doing vessel maintenance, and 2 months working on a crew in the mariculture industry
- It is possible that the wages may be provided through the program so the company hosting the student will get the labor free of charges

MAA and GOMRI have a 2000 hour apprenticeship program

