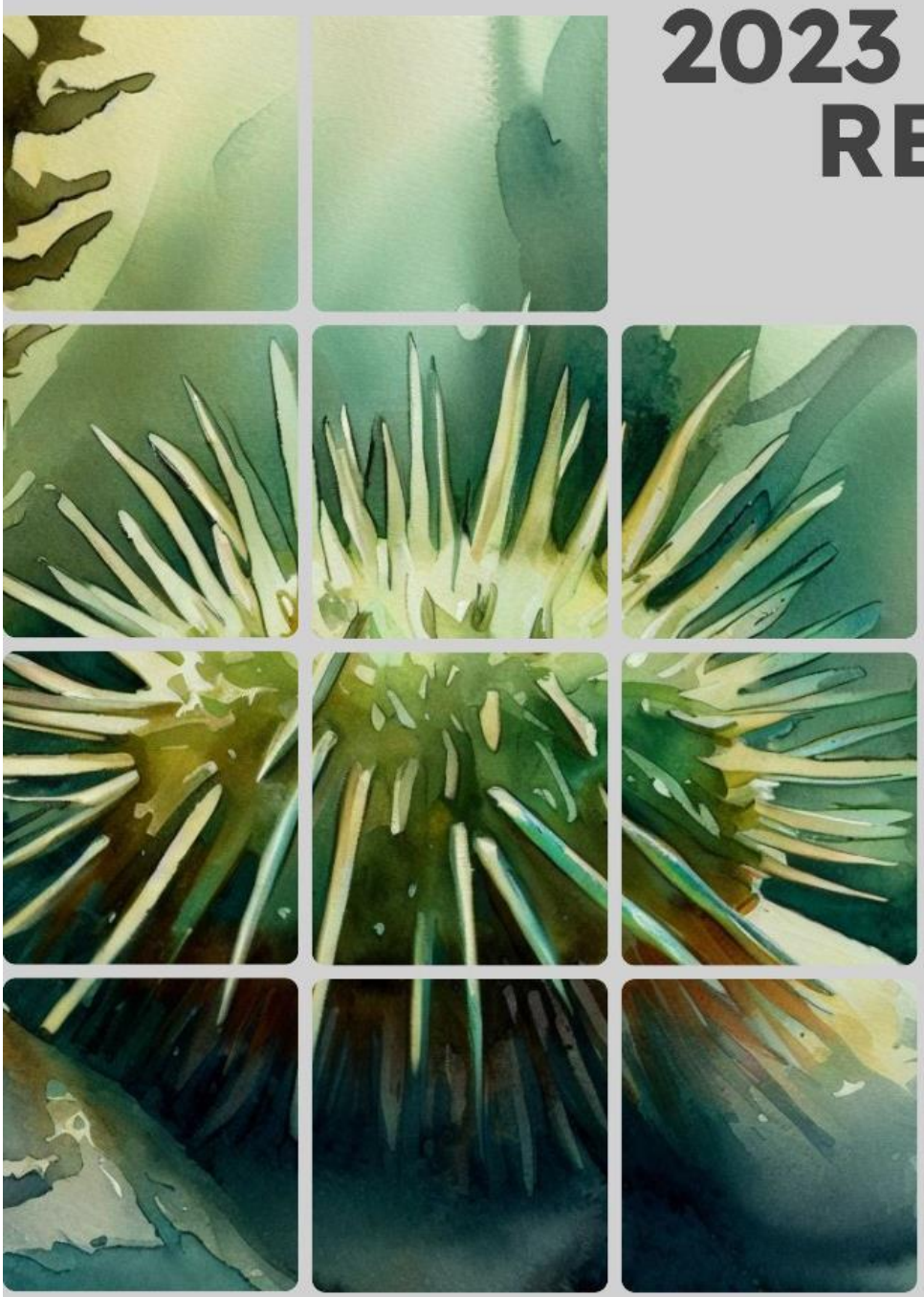


# 2023 URCHIN RESEARCH FORUM

MAINE DEPARTMENT OF MARINE RESOURCES

# Co-Authors:

Elija Bates, Maine Department of Marine Resources

AND

Parker Gassett, Maine Climate Science Information Exchange Office at the University of Maine, and Member of the Sea Grant Marine Extension Team

The following is a summary of the Maine Department of Marine Resources 2023 forum on Green Sea Urchins. This report provides information on the status and history of the urchin fishery in Maine and adjacent Canadian waters, as well as contemporary issues for fishery management and license holders. Additionally, it introduces active regional monitoring and research efforts relating to wild and cultured populations.

## Green Sea Urchin Forum Agenda

– September 15th, 2023, Maine DMR, West Boothbay Harbor

10 AM – Welcome, Carl Wilson

- Maine Department of Marine Resources: Maine Urchin Fishery Overview

10:30 AM – Presentations:

• Monica Finley, Canada DFO: New Brunswick and Nova Scotia Urchin Overview

• Luz Kogson, CCAR: Evaluation of the survival and growth of green sea urchin juveniles in two LPA sites in Maine

• Coleen Suckling, URI: Expanding Northeastern US green sea urchin aquaculture production and their potential to reduce biofouling of shellfish.

• Coleen Suckling, URI: Understanding the role of climate change on green sea urchin production– new projects & collaborative opportunities.

• Steve Eddy, CCAR: Sea Urchin Research and Aquaculture Development at the Center for Cooperative Aquaculture Research

12:00 PM - Industry hour:

- Of the changes you've seen in the past few years, what will impact your ability to harvest the most?

1 PM – Brainstorming Session

- Pressing issues and Research Priorities for Urchin Stock

2 PM – Closing remarks.

## Reflections and Opportunities for the Department

Carl Wilson, Director, Bureau of Marine Science, Maine Department of Marine Resources

The Maine Department of Marine Resources has been reflecting on the history and changes in the urchin fishery. Over the past 25 years, there has been a steady decline in the fishery, yet it continues to persist with a small group of dedicated active harvesters.

During the tenure of former commissioner Robin Alden, the Sea Urchin Zone Council was established, making it perhaps the only council with an official scientific representative sitting on it. Additionally, a research fund was put in place funded by surcharges on urchin licenses, providing significant funding for urchin research related to the fishery. Despite these efforts, the decline in the fishery has persisted.

Considering this ongoing decline, the Department recognizes the need for further investigation before implementing new management strategies. It is crucial to determine whether the decline is a result of human impacts or ecological changes. If it is a human-induced change, there is hope that corrective measures can be taken to reverse the decline. On the other hand, if the decline is driven by ecological factors beyond human control, it is essential to plan accordingly.

The Department recognizes the rich history and economic significance of the green sea urchin fishery, remembering the past "green gold rush" of urchins, which witnessed a flourishing industry. Despite the obstacles and uncertainties, the Department remains dedicated to supporting the fishery and seeking ways to sustain it. Simultaneously, it aims to ensure that the scientific research conducted for urchin ecology aligns with various interconnected and emerging requirements for ecological monitoring in the context of climate change in the Gulf of Maine.

# Maine Urchin Fishery Overview

**Lulu Bates, Melissa Smith, Robert Russell, Maine Department of Marine Resources**

Between 1985 and 1992 there were no regulations or statutes regarding green sea urchins in the State of Maine. Regulations and statutes arrived in response to the lucrative urchin fishery. States and agencies were responsive, playing catch up to produce a sustainable fishery as the fishery was emerging in real-time. Current annual changes are minor now in comparison to the initial regulatory work.

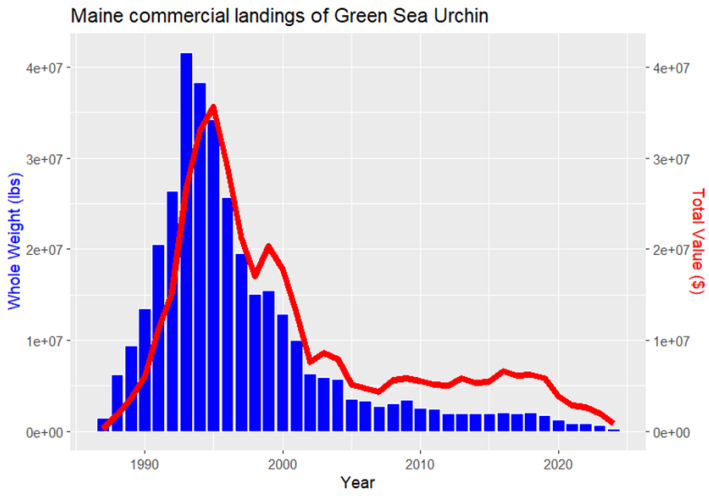



Figure 1: State of Maine commercial landings of green sea urchin.

- In 1992, sea urchin licenses were first established.
- 1993 was the peak landing year for the Maine Urchin fishery (Figure 1).
- In 1994, minimum size regulations were implemented.
- In 1994, zones and the sea urchin council were created.
- Afterward, there were modifications as the seasons rolled through (once a 150-day urchin season).
- Beginning in 2005, there are designations of early and late season harvesting.
- Continued harvest of urchins was needed to smooth out processing operations, e.g., early, and late harvest seasons provided steady landings to maintain factory demands.
- The Urchin council was later restructured to ensure better representation of the fishing participants themselves.
- Initially, there were 10 and 40-day seasons, down from once 150-day seasons.
- From 2006-2010, closures were introduced as a new management approach.
- From 2011-2015, possession limits were implemented, starting at 10 totes per license holder state-wide.
- Since 2016, there has been a swipe card system that allows you to pick your own days/conditions to fish and improves safety.
- As of 2023, there is a new management perspective in which harvest in September is excluded as it is no longer an ideal month to harvest (there were discussions about whether to also exclude October).

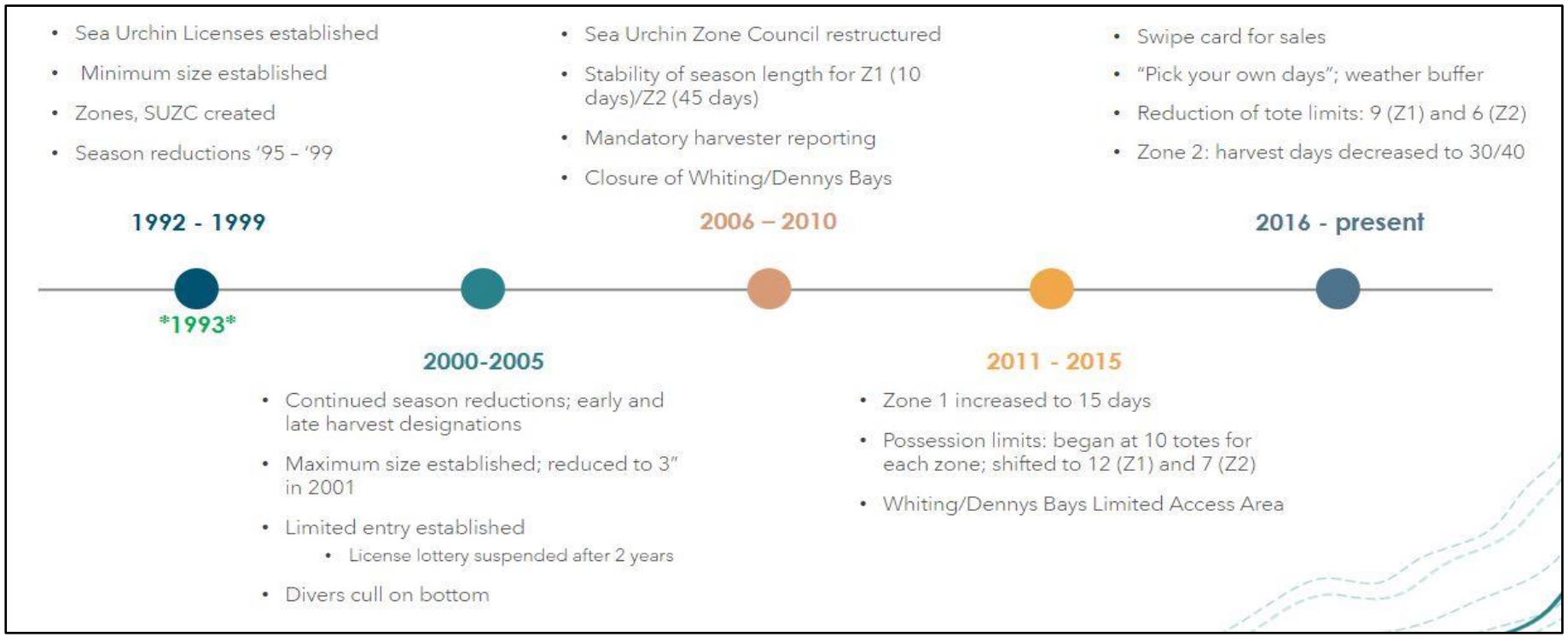


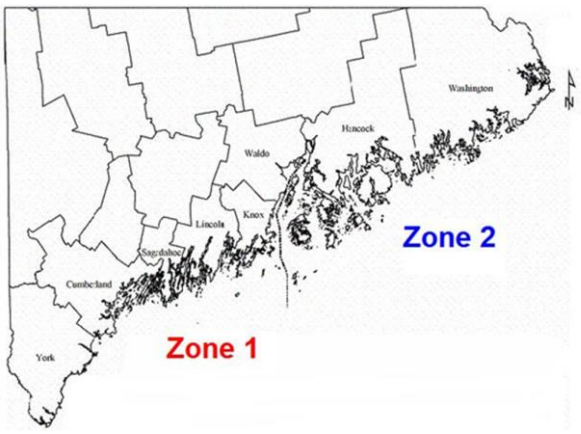

Figure 2: Timeline of commercial green sea urchin regulations in the State of Maine.

## Management as of 2023:

- Zone 1: 15 harvest days with 9 totes
- Zone 2: 30 harvest days with 6 totes
- Hand harvest (diving) and drag operators.
- Harvesters are given a tote limit per day. The weight of a tote of urchins depends on dietary quality/quantity and varies, but is typically around 90-100 lbs.

The fishery has experienced a 20-year decline, yet, certain locations and ledges consistently experience a return of urchin populations, but the exact reason for this is not fully understood. For instance, some ledges in Blue Hill Bay always replenish, prompting the question of what factors contribute to their high productivity.

The average age range of harvesters in the fishery is 55-65. The total number of active harvesters last year was 94. Hancock, Washington (Zone 2), and Knox (Zone 1) are the primary producing counties (see Map 1 and Figure 3).




Map 1: The Maine coast divided into regulatory Zones with counties listed.

Roe quality of 17% appears to be declining over the past 5 years (Figure 4). (Note: roe percentages are not always reported correctly, there is a fair amount of generalization.)

Harvester interviews are conducted to gather information about age, experience, crew, vessel length, fishing depth, method of fishing (diving or dragging), number of divers and bottom time, or drag width and type, and time spent fishing.

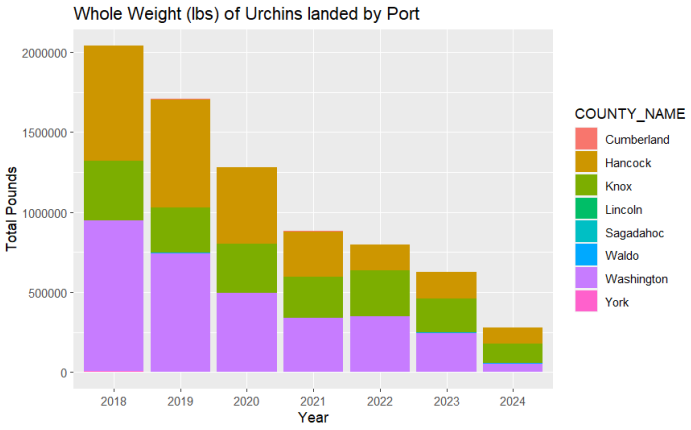



Figure 3: Commercial green sea urchin landings (in lbs.) by Maine county from 2018 – present.

Data sources include swipe card commercial landings, harvester interviews, and the "urchin survey." The spring dive urchin survey science started in 2001, many years after the urchin boom. The urchin survey is a fishery independent source of information, outside of the landings data (Figure 5).

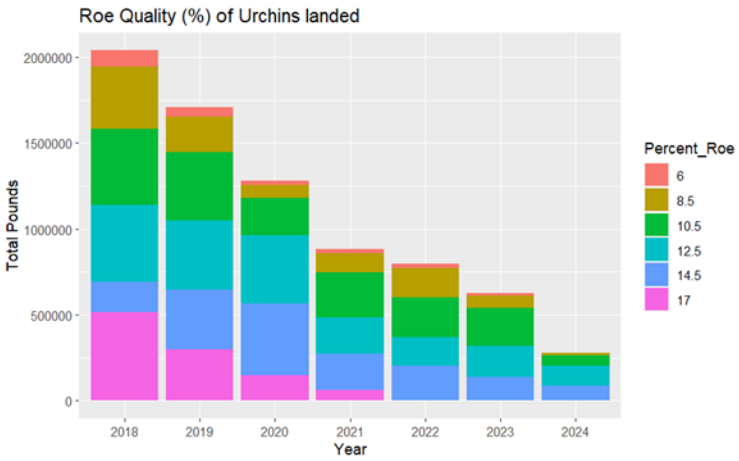



Figure 4: Roe percentage of green sea urchin catch from 2018 – present.

The urchin survey includes 5 permanent sites and 11 random sites per region. The fixed sites were established on

recommendations from urchin harvesters, and a remaining pool of GIS-mapped hard bottom sites are chosen at random to complete a total of 16 sites per region. Urchin harvesters are hired to assist with the science survey. Funding for the urchin survey is solely derived from license fees. However, with license fees atrophying, there are concerns about the sustainability of the funding stream. Over time, the survey has gradually incorporated new information, including lobster counts, sea cucumber counts, crab data, and more. The urchin survey, along with dive surveys for lobsters in the fall, could potentially serve as the underpinnings of a more comprehensive benthic ecology survey better suited for emerging issues of concern including climate change, and could be supported by alternative revenue and grant sources.

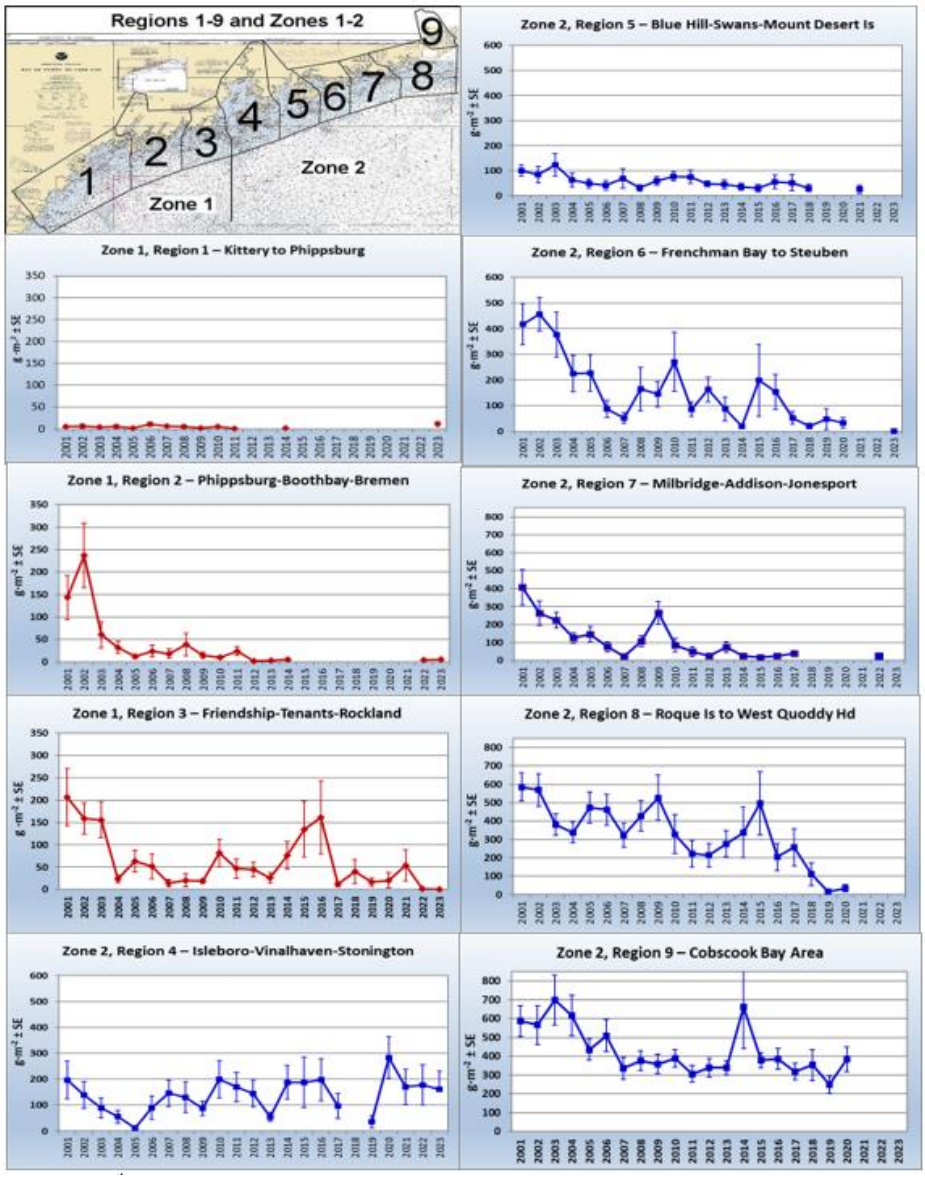



Figure 5: Green Sea urchin biomass indices from the Maine DMR urchin dive survey.

## Monica Finley, DFO: New Brunswick and Nova Scotia Urchin Overview

Urchin fisheries take place in the Gulf of St. Lawrence, Newfoundland, Nova Scotia, and adjacent to Maine in New Brunswick.

In Nova Scotia a widespread die off of sea urchins occurred in 1995. License holders report that the population hasn't recovered since re-occurring die-offs from amoeboid pathogens, which poses the biggest threat to the stock and fishery. In the 5 years between 1995 - 2000, amoeboid pathogens are believed to have killed 10-100 times the weight of urchins harvested by the fishery (Miller and Nolar, 2000, DFO CSAS Res Doc, 2000/109).

Near Maine, there are two management areas, corresponding with lobster management areas LFA 36 and 38 (sharing access to LFA 37) (Figure 6). It is a limited entry fishery, with a size limit of 51mm, no recreational fishery, some closed areas, 100% hail in/hail out, 50% - 100% dockside monitoring of trips, culling required at sea and each fisherman completes a monitoring document for each fishing trip.

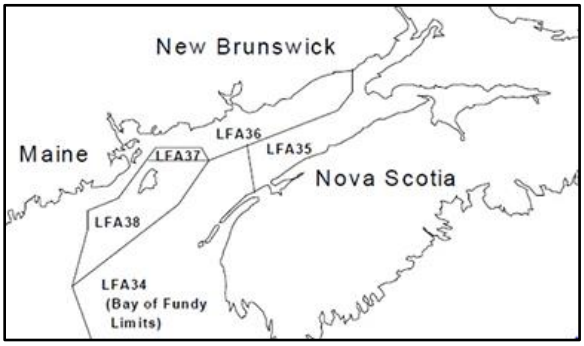



Figure 6: LFA management zones along New Brunswick and Nova Scotia.

LFA 36 has 19 licenses, with 5 for drag fishing and 14 for dive fishing. It is primarily a dive fishery. The season in LFA 36 historically spans from October 1st to May 15th, with a total allowable catch of 900 tons. LFA 38, around Grand Manan, has 13 sea urchin licenses primarily for drag fishing. It has individual quotas divided between two zones, totaling 13 metric tons per license per zone. There have been voluntary reductions in the total allowable catch in LFA 38 in recent years, as requested by license holders. The season in LFA 38 is from December to March, limited to weekdays (M-F). Landings in LFA 36 have reached their lowest point in the time series in 2022.

There is limited information available for the Department of Fisheries and Oceans to assess the situation in LFA 36 and 38 due to the lack of focused surveys (last peer-reviewed urchin science conducted by DFO occurred in 2010).

### Claire Goodwin, Huntsman Marine Science Center:

A dive survey conducted by the Huntsman Marine Science Center provided some distribution information for the fishery. The survey focused on benthic habitats and recorded the species and substrates present. The survey found that sea urchins were only present at 5 out of 41 surveyed sites (Figure 7). Recent drags have yielded very small urchins. The abundance of sea urchins varied among the sites, with some sites showing occasional or frequent presence. This contrasted with a base survey conducted 40 years ago where urchins were abundant or common at the majority of sites surveyed.

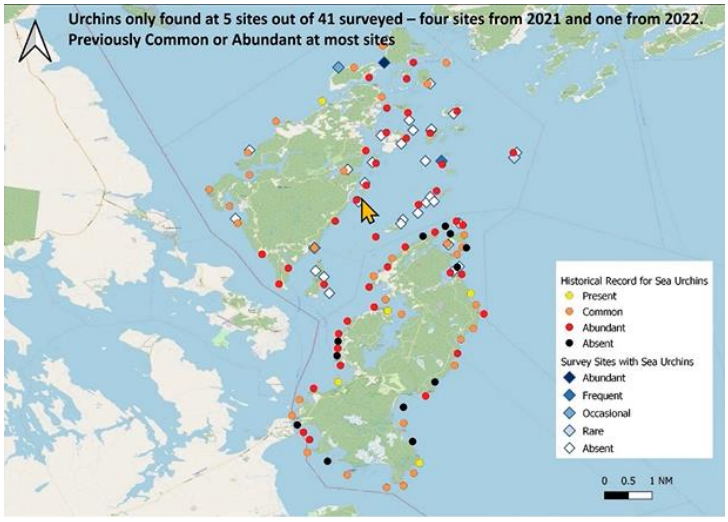



Figure 7: Dive survey sites from Huntsman Marine Science Center benthic habitat survey.

Further studies are needed to understand the dynamics of sea urchins in the area. Fishing area is not consistently reported, consideration to update the fishing logbook information, and there is interest in learning from and possibly replicating the survey format conducted by Maine DMR.

**Q&A Highlights:**

- *Cancer borealis* not seen in Eastport until 2013, abundant in Canadian waters now.
- Fishing area in Canada not consistently reported, DFO is considering working that into logbook requirements moving forward.

## Luz Kogson, CCAR: Evaluation of the survival and growth of green sea urchin juveniles in two LPA sites in Maine

Green Sea Urchin Research at the Center for Cooperative Aquaculture Research aims to address the need for reliable and affordable seedstock for profitable sea urchin aquaculture, while conducting research to understand the optimal substrates and conditions for successful larval settlement of sea urchins in the hatchery production process. With funding from the Atlantic States Marine Fisheries Commission (ASMFC), this work focuses on improving hatchery production, providing no-cost seed to growers, and expanding sea urchin aquaculture in Maine and other Northeastern states.

Our project has three main objectives:

1. Evaluate the effectiveness of two settlement substrates (bio-barrels and pebble polycarbonate/acrylic plates) as settlement and growth substrate for juvenile sea urchins with sugar kelp, dulse and ulva seedlings.
2. Evaluate the survival and growth of the juvenile sea urchins in bottom cages at three different stocking densities.
3. Evaluate the survival and growth of the juvenile sea urchins using laboratory- seeded sugar kelp and wild-set fouling organisms (macro-alga and invertebrate) in an oyster farm setting.

Summary of work:

Mature and ready-to-spawn sea urchin broodstock were collected from Frenchman Bay and brought to the Mariculture Laboratory at CCAR–UMaine. They were spawned following CCAR's current protocol and food was made available for the produced larvae. While the developmental stages were being carried out in the nursery, settlement tanks were set up and conditioned with kelp, dulse and ulva seedlings to facilitate the metamorphosis and settling of the competent larvae. Competent larvae were stocked, fed, and monitored for growth for five months, then distributed to Co-PIs who began trials on their farms. Ocean Resources Inc. implemented the use of bottom cages with three stocking densities (100, 150, and 200 juveniles per cage), and Winnegance Oyster Farm added juvenile sea urchins into an existing oyster farm to test two

readily available food sources for suitability as urchin feed: laboratory-seeded sugar kelp and wild-set fouling organisms (macro-algae and invertebrates).

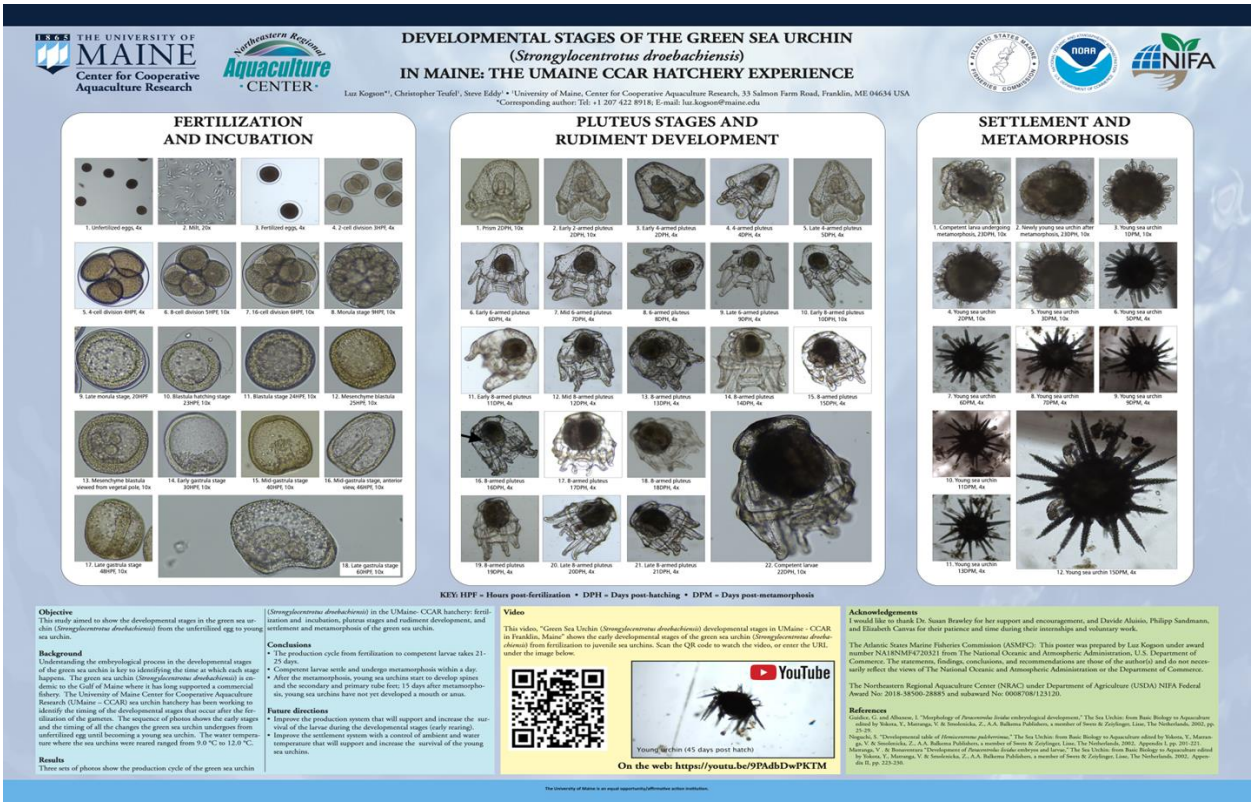



Figure 8: Poster of developmental stages of the green sea urchin in Maine by CCAR.

Firstly, we successfully replicated the hatchery process and closely monitored the stages of incubation, rearing, and metamorphosis, creating a series of posters with photos of each developmental stage (Figure 8). Secondly, we conducted experiments to test different substrates for settlement and evaluated their effectiveness. Thirdly, we explored the potential for commercialization and the development of value-added products from sea urchins and evaluated the survival and growth of green sea urchins in two different locations (Jordan River, New Meadows River) as complimentary species for existing aquaculture.

Jordan River in Hancock, ME is our study site with Ocean Resources Inc. Sea urchin juveniles (10-15mm) were placed in cages with 3 densities: 100, 150 and 200 juveniles per cage to test survival and growth.

New Meadows River is our study site at the Winnegance Oyster Farm, in West Bath, ME. Sea urchin juveniles were placed in cages with different diets: Kelp, fouling and mixed. Preliminary results show the best diet option to be mixed.

We encountered challenges such as a heat wave and possible anoxia, resulting in the unfortunate loss of our sea urchins. Nevertheless, we collected valuable data from these

experiments and remain committed to further research. The project is still ongoing, planning to end field trials in May of next year on our Jordan River in Hancock, ME study site with Ocean Resources Inc. We greatly appreciate the support and collaboration from our partners, and we eagerly anticipate future research and discoveries.

**Q&A highlights:**

- Some research and observations are finding that smaller urchins are more resilient to temperature changes.
- Growth rate of 40% between placing them in the aquaculture locations and urchins dying in April (lack of oxygen caused urchins to die). Very important to consider land contamination leaching into the water.
- This was an incredible year for mussel spat, and mussels and urchin's co-habitat well together. Harvesters used to look for baby mussels to find the best quality urchins; mussels are nature's water filter.

## Coleen Suckling, University of Rhode Island (URI): Expanding Northeastern US Green Sea Urchin Production and their potential to reduce biofouling on shellfish.

One of the main challenges in the green sea urchin industry is slow growth, which can be attributed to factors such as lack of awareness and high seed costs (0.25 cents - 0.32 cents per seed) currently settlement and post-settlement survival in a hatchery is 1 to 5%). Work has been underway to optimize production methods and reduce seed costs. Namely, experimentation with treatments, such as pretreating seawater with food sources and creating biofilms to act as a cue for settlement and food source for newly settled juveniles (Figure 9). The use of biofilms created in the presence of adult sea urchins has shown promising results in achieving high settlement success rates. As hatchery techniques improve and costs decrease, it will become additionally important to promote awareness among growers and provide technical advice and resources.

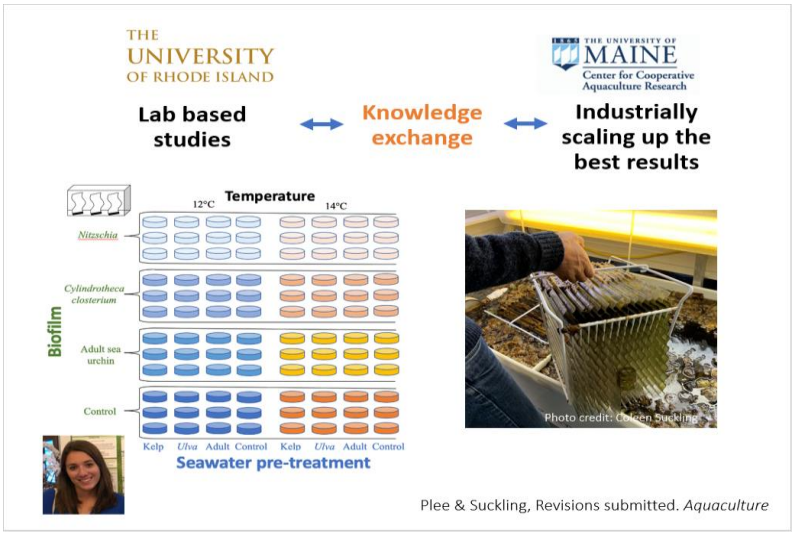



Figure 9: Project set up for testing urchin settlement and post-settlement survival under different seawater treatments and biofilms.

The University of Rhode Island partnered with the University of Maine's Center for Cooperative Aquaculture Research (CCAR) Director Steve Eddy, the region's only operational green sea

urchin hatchery at the time of this report. URI conducted large trials to identify the best performing results, which could then be translated to the CCAR hatchery at industrial scale.

Our results showed that the biofilm with the most settlement success was the biofilm created in the presence of adult green sea urchins (Figure 10), with a success rate of 80-90%. CCAR is now testing this method in their facilities.

The lab work has been published in the peer-reviewed Journal Aquaculture and is available here:

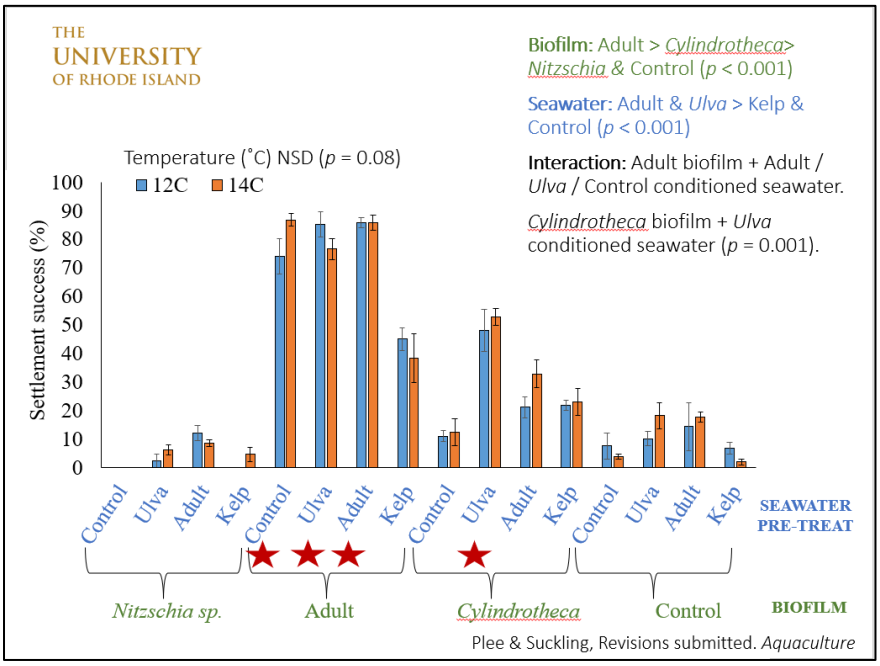



Figure 10: Green sea urchin settlement success across different seawaters treatments and biofilms.

https://doi.org/10.1016/j.aquaculture.2023.740386

Additionally, an aspect of this project was increasing awareness about green sea urchin aquaculture. We've been doing a lot of work reaching out to aquaculture growers and providing free information to those interested (workshops and free technical guidance on grow out). As part of the project, we've also been giving new growers free seed (more than 166% uptake since starting this outreach). Anyone interested - please reach out! We are looking for more participants. (https://umaine.edu/cooperative-aquaculture/sea-urchin-hatchery-seed/)

There is potential to supplement the fishing industry in the northeastern US by expanding green sea urchin aquaculture. Polyculture integration of green sea urchins with shellfish is being explored to reduce biofouling. Studies have shown a significant reduction in biofouling and improved shellfish growth; urchin integration has yielded 30-100% reduced biofouling and enhanced growth rate by 30-500% in some shellfish (Figure 11). Trials involving green sea urchins and Atlantic Sea scallops, as well as Eastern oysters, are underway to determine optimal conditions and density for effective biofouling reduction and enhanced shellfish growth.

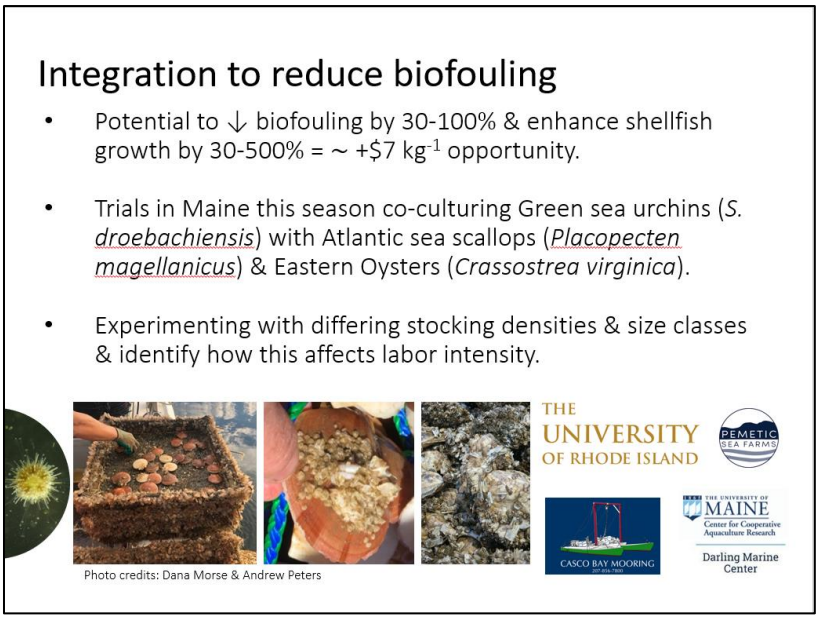



Figure 11: Slide grab of laboratory project results and next steps.

**Q&A Highlights:**

- Large urchins encourage larval settlement = protection for small urchins.
- Wild supplementation with this seed is something to consider.

## Coleen Suckling, URI: Understanding the role of climate change on green sea urchin production – new projects & collaborative opportunities.

This project combines studies I've done in the past with new ones moving forward looking at the role that climate change has on green sea urchin production.

These will combine laboratory and field-based projects. One study I've completed was to raise 3 generations of European green sea urchins *(Psammechinus miliaris*) in the lab under different scenarios of warming and ocean acidification (7-year project).

An overall snapshot of what I've found is that different generations give different responses (Figure 12). First generation (original parents) were collected from the wild, brought to the lab and introduced into climate change scenarios for a full reproductive cycle to see how they respond. Their metabolic status was disturbed, and their spawning period was reduced.

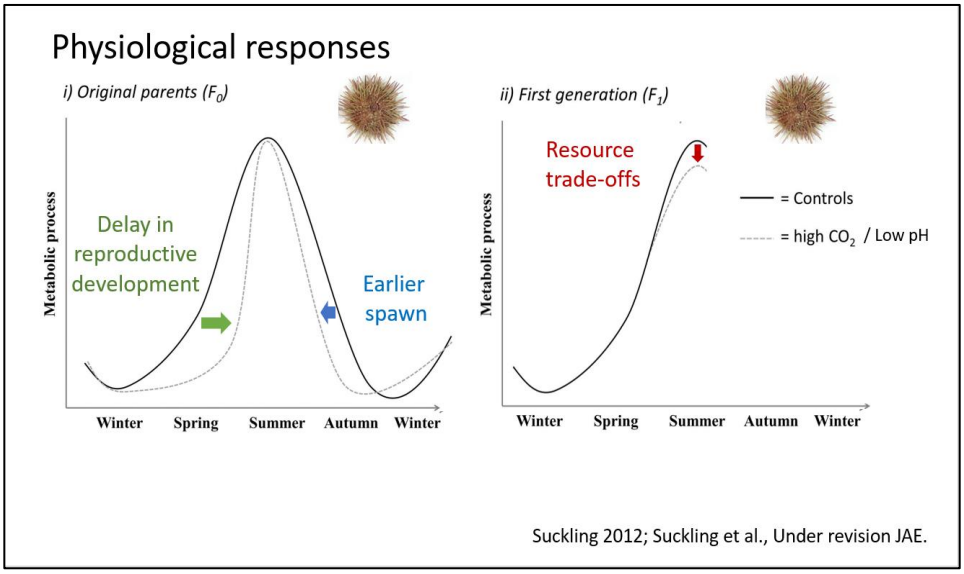



Figure 12: Physiological responses of European green sea urchin generations in the ocean warming and acidification study.

However, the next generation (First generation offspring) no longer had a narrowing of the reproductive window. Instead, they reallocated their metabolic budget to invest more in eggs and less into their own skeleton (test), to give their offspring a better chance of survival. Which also translated into more marketable gonad tissue where the edible uni became 30-50% larger and maintained strong market colors.

Now, we are using modeling tools to determine spatial and temporal distributions. This work contributes meta-science on a northward shift of the southernmost range of urchin distributions. (With a 1990 as a clear delineating range of ~4 degrees north). The literature and dataset review will then lead to a model, still under development. What parameters should we include in the model outside of temperature? What variables? *Request for data to be used in this model. Request for collaborators.*

Next part of the project: Is market timing shifting with climate? (e.g., urchins spawning time changing). This work is being coupled with field measurements looking at characteristics of population and marketability of the urchins themselves. Monthly field sampling of urchins along the coast of Maine for 2 years to answer, "what's happening now"?

Sites chosen are sites previously sampled in the 80's and 90's - does anyone have any recommendations?

**Q&A Highlights:**

- Red algae being seen more and more by Canadian harvesters.
    - Seeing it around urchins, scallops, surf clams

    - When it seems to be attached to urchins, we see more cancer spots/drooping of spines.
    - If the area is completely covered with it = no urchins
    - *Dasysiphonia japonica* – red invasive seaweed
- Parameters to add to Models.
    - Influence of freshwater/salinity
    - Tidal flow
    - Turfing red algae, “red death”
    - Depth
    - Bottom type
    - Presence of existing urchin stock
    - Presence and species of algae

## Steve Eddy, CCAR: Sea Urchin Research and Aquaculture Development at the Center for Cooperative Aquaculture Research

Director of CCAR, Center for Cooperative Aquaculture Research. It was established in 1999, and CCAR is a multi-species research, development, and business incubator facility for aquaculture. We don’t just work on urchins but work across species in aquaculture settings. I am also a member of the Sea Urchin Zone Council (SUZC) as the aquaculture representative. It is very unusual to have an aquaculture representative on a fisheries council, as is the case with the SUZC.

The rationale behind it is twofold:
1) Japan has a long history of using aquaculture methods to enhance their wild stocks.
2) Urchin hatcheries started at two locations in Maine when the fishery began to decline, so it made sense to have an aquaculture representative on the SUZC.

CCAR got involved in sea urchins looking at nursery methods in 2005 with Larry Harris and Jim Wadsworth. In 2007, we put in aquaculture tanks for Urchins, and have thus been able to leverage that to facilitate services into several projects and grants enabling a variety of aquaculture trials. We have engaged in lab work, fieldwork, reseeding, and gonad enhancement projects with different feeds to bulk them up in 12 weeks before market.

We are a client driven facility; the University of Maine doesn’t have a sea urchin research program. All sea urchin research at CCAR has been upheld 1 grant at a time. We would like to continue sea urchin research, but it must be paid for via grants. That is our challenge moving forward as funding is the only way to sustain this endeavor, but if industry, processors, researchers, and all of you are interested, I think we’ll be able to keep this effort going for a while. Thank you.

***Larry Harris**:* I just want to make sure that two people who were instrumental in getting the sea urchin fishery/research started were Ben Baxter (Sea Grant) and Bruce Chamberlain (DMR). Very important people in the early arc of Maine's urchin fishery.

## ***Discussion Session:*** *the discussion session was open format and collaborative.*

### *Highlights*

**Data Needs:**

- How to use/interrogate existing data?
- How can science/industry add to those data sets?
- What urchin food sources produce high-quality roe?
- Water quality dataset over time in coastal areas
- Maine DMR needs to communicate to Maine industry about industry and science in other countries with urchin problems (e.g., Canada)

**Open Discussion:**

- What diversity exists in urchin genetics by location? Help in understanding larval drift?
- Within a zone: noticing different preferences for harvest? Urchin spawning times differ along the coast. How can/should DMR respond?
- Canada: Environmental shifts have led to interest in a later start to the fishery.
    - DMR notes that this year is the first in the urchin fishery to forgo September due to poor quality urchins.
- Kelp communities are changing, receding northwards.
- In outer coast: increase in larvae but decrease in survival bears on future work in reseeding or enhancement.
    - Larval urchins landing in wrong habitat/no good food source.
- Differential settlement vs differential survival, by location. Would be valuable to understand more completely.
- Roe quality has been decreasing over time. Best roe from hair algae
- 'Spots' on urchins: Temperature stress? Unknown cause.
- What about the possibility that herbicides/pesticides on coastal lawns may be killing urchins?
- Mechanisms to share information with Canadian colleagues, need greater information sharing among fields/different fisheries.
- There are areas with remarkable kelp diversity and food supply for urchins yet there are no urchins. Why is this? Why are the larvae not surviving?
- Cobscook Bay could be an area of study both US and Canada could collaborate on? Considered a "unicorn" because it's an area that can primarily self-support and self-seed.
- Aquaculture helping restock wild populations. Concerns:
    - Potential for disease/biosecurity
    - Seeding areas that are good bottom but bad for urchins.
    - Potential barrier: using taxpayer money to pay for urchin seed.

## Discussion Q&A:

**Q:** Two big issues for me are: 1) what will DMR do about low numbers of licensing and how to get new licenses? 2) how will processors stay in business?

**A:** 1) That's always the big issue. How do you say we're going to open licenses again to the survivors of this industry? Something we hear a lot is: *"If you are going to let someone new into the fishery, no way, give us back our 50 days of added harvest season."* It's a balancing act of adding new entrants, vs. timing considerations with other fisheries. 2) As long as urchins stay here, we will keep buying and processing.

*Comment:* A problem with a license lottery and opening the fishery, most people won't be able to find the urchins. It's only the guys who have been doing it for a long time that know where to look and have it narrowed down to those few spots.

**Q:** Does the dive survey show any urchin barrens coming back?

**A:** I don't think we'll ever see those big barrens come back. It's more of a mosaic. Seemingly the resource and permitting is right sized - current fishers can meet their quota.

**Q:** What about reseeding? Have there ever been any projects reseeding/relocating wild areas?

**A:** There have been a couple, none were successful. The urchins we put there did not stay. It's all about biomass. Cobscook and Cat Ledges projects, harvested in one area and brought them to a new area. Over time the patch did not stay. We can go through the effort of relocations or reseeding but unless there's a quick turnaround for bulking it does not appear to reestablish. There isn't enough biomass in total to produce enough spawn for a viable population. There is not enough biomass to kick off a new population boom. Need to figure out what is going on in our ocean bottom and on the shorelines.

*Comment:* DMR needs to work on understanding overall benthic conditions, changing conditions, and possible pollution to add context to the recovering populations. What's going on? What ecosystem changes? Not just urchin specific.

**Q:** How does DMR feel about using hatchery seed to supplement wild population recovery?

**A:** It is political. Unanswerable today. From a statute or a regulatory standpoint, there does not seem to be a barrier to the possibility of hatchery assistance, though the typical framing of the commissioner would prefer that this kind of intervention be the product of consensus across the fisher - as a bottom-up request/bottom-up collaboration - that is unifying for the fishery.

***Doug Rasher:*** Quickly wanted to mention the research we've been doing lately. We've been working with DMR analyzing the 20-year dive survey data set with respect to algal and urchin dynamics. We've also been doing more high-resolution surveys at similar sites to look at how

the composition of algae is changing. Our research is primarily focused on the outer shore, exposed points, outer coastal islands etc. Over the last 20 years kelp forest dynamics have shifted quite a bit, average abundance in kelp in any given area has slowly but significantly declined over the past 20 years. It used to be lusher and have a wider variety of kelp species. Kelp forests in Casco Bay south to York have largely collapsed; it has been largely replaced by scuzzy filamentous red algae. An important consideration as we move forward and the Gulf continues to warm is the changing of food availability for the urchins, Kelp is going to recede further north. We have some sites in the mid coast region that were healthy 5 years ago and have now switched from kelp dominated to red algae dominated over that period. So, it's a very rapid transition.

Another thing I wanted to mention is the lack of adult and baby urchins at our long-term sites. However, when we put out larval settlement collectors in 2018 and retrieved them in 2019, we found there still is a rain of baby urchins at these sites. They are settling, but not surviving. What is limiting urchin recruitment and survival into adulthood on the outer coast?

**Q:** Can you overlay this change in algal distribution abundance over temperature change?

**A:** Yes, we developed models that considered spring temperatures, summer temperatures of the year prior and the density of urchins. We broke up our analysis by sub-region, knowing the dynamics are different in these areas. We considered both the average temperature change that happened in each region and the anomalies over those 20 years. Our model showed all three factors to be significant and all strongly linked to the decline of kelp over space a time, with temperature being the most significant factor.

**Q:** What are the major kelps in Maine?

**A:** Sugar kelp, horsetail kelp, wing kelp and shot kelp. We've seen a shift more towards horsetail kelp than the other 3.

**Q:** Do the dive and drag fishery happen in the same area or different locations (Maine fishery)?

**A:** Draggers can access deeper water and can fish in tides. Divers can access the shallow, rocky habitats where drag gear cannot go. However, they also dive hard bottom, and sometimes it's "too close for comfort". Divers must consider depth and currents before fishing, as well.

**Q:** What about zone rotations for urchins? Especially with reseeding, to allow urchins a year or two to grow?

**A:** Not currently, there is a Limited Access Area in Whiting & Dennys Bay. My concern is knowing there will be an area that will be boosted and closed to allow it to grow - when it's open again, how do you stop everyone from going there and fishing down that population? However, that would be a good discussion to have within the state if we ever did approach a reseeding project.

***Larry Harris:*** Urchin dive survey is critical. Funding is the biggest issue. Sea urchins spend 30 days floating around in the Gulf of Maine, Urchin plutei get mixed in the water column and settle everywhere. My strong observations over a long period of time; this is an issue of differential survival and not an issue of differential settlement. What you're getting in these different habitats are localized adaptations/physiological adaptations based on habitat (exposed, protected etc.). Things are changing fast, it's a whole mix of things, but it would be nice if we could add aquaculture issues into the mix - but where's the funding?

***Jesica Waller:*** Larry touched on funding and lack of it, Lulu put forward a Sea Grant proposal to fund the dive survey and turn it into a more benthic ecology focused survey, we will continue to pursue that but yes, funding is an issue. A lot of the money, federal and state, run on 5-year cycles. The next one is coming up in 2025. Things that we can build together in the next year or so that we could have outputs to show in the next 5 years would be immensely helpful for us to show these data outputs and try to secure more long-term funding.

**Q:** What about urchin disease? Anyone noticing spots?

**A:** We noticed more spots on our urchins last year than ever before (Maine).

***Monica Finley:*** Canadian harvesters have also been noticing cancer spots on the urchins up here. It is a real concern. Huntsman Marine Science Center is a frequent collaborator with urchin pathology. DFO has zero federal staff capacity for urchin and other "secondary" species. It's being explored if the dive survey conducted in Maine could be the right survey for Canada to replicate the same/similar data/methods.

**Attendance List:**

**IN PERSON:**

Doug Rasher (Bigelow Laboratory)
Dara Yiu (PhD Student)
Shane Farrell (PhD Student)
Marcus Jones (Active Urchin Harvester)
Atchan Tamaki (Buyer/Processor)
Colleen Suckling (URI)
Steve Eddy (Director of CCAR)
Larry Harris (UNH)
Luz Kogson (CCAR)
Michelle Staudinger (UMO)
Joe Leask (SUZC Member, Active Urchin Harvester)
Carl Wilson (DMR, Bureau of Marine Science Director)
Maggie Hunter (retired DMR Biologist)
Jesica Waller (DMR, Biological Monitoring and Assessment Division Director)
Robert Russell (DMR, invasive species, lobster, and dive safety)
Lulu Bates (DMR, Northern shrimp, urchin, and sea cucumber)
Melissa Smith (DMR, Scallops, urchins, and herring)
Heather Glon (DMR, Lobster biologist and co-dive safety officer)
Dana Morse (Sea Grant)
Parker Gassett (MCSIE, Sea Grant)

**VIRTUAL:**

Tony Lyons (Industry, LFA 38)
Corey Mitchell (Industry, LFA 36)
Jason Lomax (DFO, Conservation and Protection)
Janie Jones (Quoddy Savour Seafood Ltd)
Brooke Lord (Quoddy Savour Seafood Ltd)
Andrew Cooper (DFO, Research Scientist)
Kristin Dining (Province of New Brunswick)
Claire Goodwin (Research Scientist, Huntsman Marine Science Centre)
Monica Finley (DFO, a/Senior Advisory)
Charlene Bergeron (CBSVI)
Kathleen Macgregor (DFO)
Ehab Misk (Huntsman Marine Science Centre)