Gonad yield & sensory attributes of green sea urchins fed dried kelp, fresh kelp, or a formulated diet

Stephen Eddy, Mary Ellen Camire, Denise Skonberg,
and Kenn Ung Wei University of Maine

Presented by Stephen Eddy

Center for Cooperative Aquaculture Research

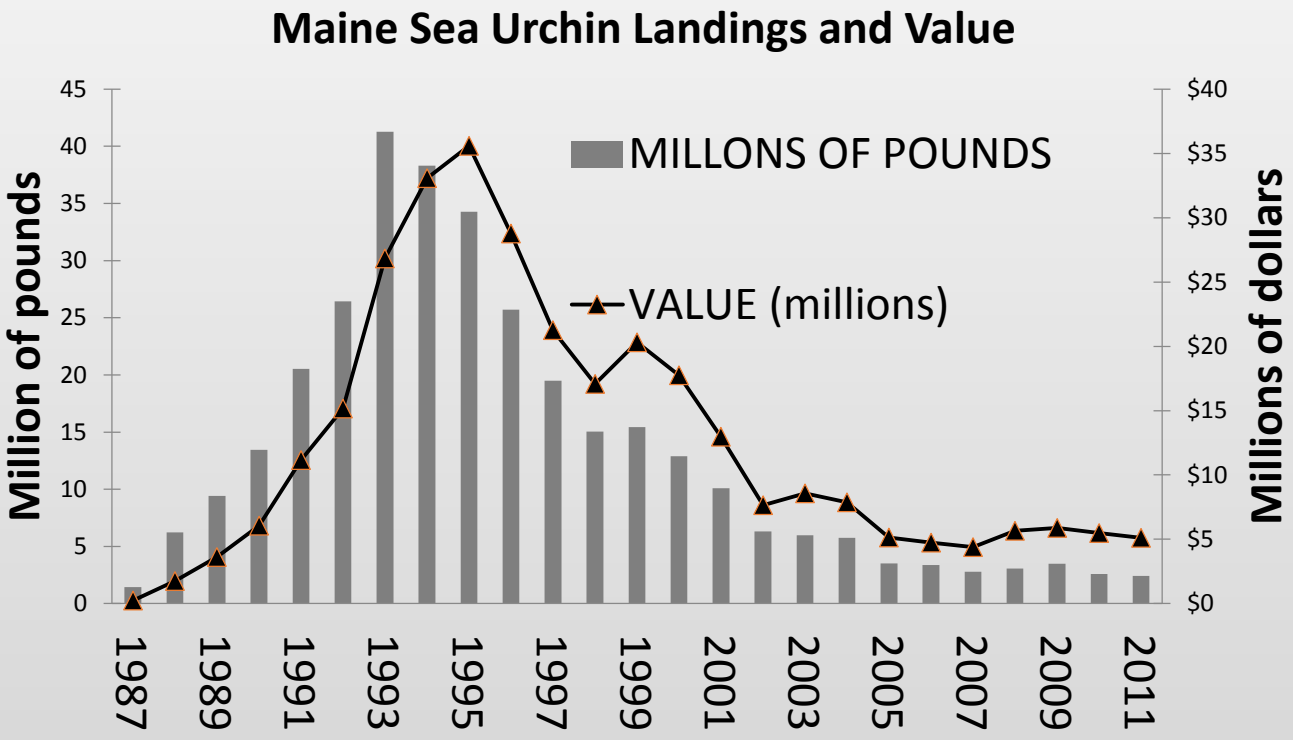
1865 THE UNIVERSITY OF MAINE

- PROJECT: From capture to culture: adding value to the sea urchin fishery with aquaculture
- FUNDING AGENCY: NOAA Sea Grant, 2012-2014

PROJECT GOALS

- ❖ Add value to the Maine sea urchin fishery
- ❖ Intensive land based gonad enhancement
- ❖ Complete sea urchin aquaculture, from hatchery to plate
- ❖ Aquacultured kelp as a sea urchin feed
- ❖ Compare kelp with formulated feed for gonad enhancement
- ❖ Compare quality of cultured urchins vs captured urchins

RATIONALE



Endangered Fishery

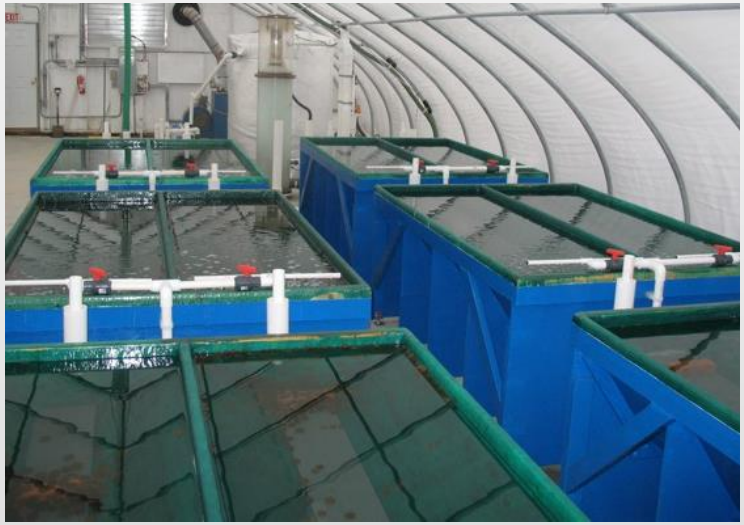
- Fewer fishermen and smaller catches
- Fewer processors: consolidation & competition
- Need to maximize value of a limited resource

Sea Urchin Bulking

Gonad Yield	Sea urchins (lbs)	Uni (kgs)	Value @ $90 per kg	Value over 28 week season
7%	4,000	127	$11,430	$320,040
10%	4,000	181	$16,290	$456,120
15%	4,000	272	$24,480	$685,440
20%	4,000	363	$32,670	$914,760
25%	4,000	454	$40,860	$1,144,080

A 5% increased gonad yield for one processing day per week could add >$200,000 in income over the season

Tank Culture



V-troughs

Platter tank

Urchin Platter

Captured and Cultured Sea Urchins

- Cultured sea urchins reared in hatchery (2009) to market size (45-55 mm TD) in V-troughs in RAS
- Reared with Nofima diet

- Captured urchins harvested at legal size (+52 mm TD) and acclimated to culture conditions
- All cultured or captured urchins were starved for 8 weeks prior to gonad enhancement trials

- Freshly harvested live “top quality” sea urchins purchased from processor Botaka Trading used for comparison in Sensory Evaluation

Feeds

- Fresh sugar kelp *Saccharina latissima* harvested bi-weekly and stored in cold flow through seawater

- Dried sugar kelp & oarweed kelp *Laminaria digitata* purchased from commercial harvester, stored in boxes
- Dried kelp was considered advantageous due to ease of storage and handling

- Nofima diet from Norway. *Protein 21.3%; carbohydrate 46.2%; fat 7.5%; ash 14.2 %; water 10.6%*
- Extended storage, nutrient dense, formulated for somatic growth and optimum gonad quality

Feeding Trial

Treatment groups

1) Captured urchins fed mixed dried kelp in Platter tank
2) Cultured urchins fed mixed dried kelp in Platter tank
3) Captured urchins fed Nofima diet in V-trough
4) Cultured urchins fed Nofima diet in V-trough
5) Cultured urchins fed fresh *Saccharina latissima* in V-trough
6) Cultured urchins fed mixed dried kelp in V-trough

➢ Groups fed 1x per week in excess of consumption

Replicates

- Replicate=One platter cage holding 32 urchins, 8 per compartment
- Platter tank: 20 platter cages for each of the 2 treatment groups, arranged in rows
- V-troughs: 4 platter cages per treatment group, randomly distributed amongst four V-trough tanks

Assessment

- Randomly sampled at weeks 0, 6, 12, and 20
- Gonad Somatic Index (GSI): weeks 0, 6, 12, 20
- Moisture content weeks: weeks 12, 20
- Hunter colorimeter, L*a*b* scale (lightness, redness and yellowness): weeks 12, 20
- Texture Analyzer model TA-XT2i: weeks 12, 20

Hardness: kg force needed to compress gonads by 50%

Resilience: “springiness” ability to regain shape kg/sec

- Sensory evaluation: week 20
- Comparisons with ANOVA and Tukeys test

Results, GSI

	start	Week 6	Week 12	Week 20
Cultured, dried kelp, Platter Tank	5.4%	5.1%	16.8%[b]	19.1%[b]
Captured, dried kelp, Platter tank	12.9%	13.2%	16.4%[b]	21.0%[b]
Captured, Nofima diet, V-trough	12.9%	23.1%	30.1%[a]	ND
Cultured, Nofima diet, V-trough	5.4%	22.7%	27.8%[a]	33.4%[a]
Cultured, fresh kelp, V-trough	5.4%	6.8%	12.0%[c]	ND
Cultured, dried kelp, V-trough	5.4%	7.5%	16.3%[b]	ND
Freshly harvested wild	ND	ND	ND	20.8%[b]

- Nofima diet outperformed fresh or dried kelp diets
- Dried kelp diet outperformed fresh kelp diet

Results, Moisture

	Week 12	Week 20
Cultured, dried kelp, Platter Tank	81.5%	77.8%[a]
Captured, dried kelp, Platter tank	79.5%	78.4%[a]
Captured, Nofima diet, V-trough	77.6%[b]	ND
Cultured, Nofima diet, V-trough	79.4%[ab]	75.8%[ab]
Cultured, fresh kelp, V-trough	80.4%[ab]	ND
Cultured, dried kelp, V-trough	82.7%[a]	ND
Freshly harvested wild	ND	73.6%[b]

- Dried mixed kelp produced gonads with slightly higher moisture content
- Freshly harvested urchins had gonads with lowest moisture content

Results, Texture

Hardness units= kg of compression Resilience units= kg per second	Week 12 hardness	Week 12 resilience	Week 20 hardness	Week 20 resilience
Cultured, dried kelp, Platter Tank	0.16 kg	0.16 kg	0.07 kg/sec	0.18 kg/sec
Captured, dried kelp, Platter tank	0.16 kg	0.16 kg	0.08 kg/sec	0.27 kg/sec
Captured, Nofima diet, V-trough	0.07^{c} kg	0.11 kg	ND	ND
Cultured, Nofima diet, V-trough	0.08^{bc} kg	0.10 kg	0.09 kg/sec	0.21 kg/sec
Cultured, fresh kelp, V-trough	0.19^{a} kg	0.14 kg	ND	ND
Cultured, dried kelp, V-trough	0.14^{ab} kg	0.14 kg	ND	ND
Freshly harvested wild	ND	ND	0.07 kg/sec	0.25 kg/sec

- Cultured urchins fed fresh kelp had firmer gonads at week 12
- Nofima fed urchins, cultured or captured, had the least firm gonads at week 12
- No significant differences seen with texture at 20 weeks

Results, Color

	Week 12			Week 20		
	L lightness	a red	b yellow	L lightness	a red	b yellow
Cultured, dried kelp, Platter Tank	46.9	15.2	38.3	50.7^{b}	17.7^{ab}	34.1^{ab}
Captured, dried kelp, Platter tank	48.9	16.6	32.0	52.0^{ab}	15.5^{b}	28.8^{b}
Captured, Nofima diet, V-trough	52.4^{a}	18.4	35.6	ND	ND	ND
Cultured, Nofima diet, V-trough	52.9^{a}	17.5	33.4	50.2^{b}	20.0^{a}	33.5^{ab}
Cultured, fresh kelp, V-trough	42.8^{b}	17.0	29.0	ND	ND	ND
Cultured, dried kelp, V-trough	50.3^{a}	15.1	30.5	ND	ND	ND
Freshly harvested wild	ND	ND	ND	55.9^{a}	20.9^{a}	41.1^{a}

- Cultured urchins fed fresh kelp had darker gonads at 12 weeks
- Freshly harvested urchins had lighter gonads with more red and yellow coloration than any of the urchins in culture
- Nofima fed urchins were closest in color to freshly harvested

Summary

- Highest gonad yield and fastest increase was obtained with Nofima, but dried mixed kelp diet also had satisfactory results
- Poorest results seen with fresh kelp, smaller and darker gonads at 12 weeks, although possibly better texture
- Freshly harvested urchins had “drier” gonads with desirable color characteristics

Do you like to eat uni?

A University of Maine graduate student is studying the effects of diet on the eating quality of fresh green sea urchin roe (uni).

Date: **Thursday, October 16, 2014**

Place: **Sensory Evaluation Center, Hitchner Hall 168, University of Maine, Orono.**

Appointments are required.

Volunteers will receive $10 cash upon successful completion of the test that will take no longer than 30 minutes of your time. If you do not evaluate all 4 samples, you will not receive any money.

You must be at least 18 years of age and eat uni at least twice a year to participate.

If you do not eat uni, are allergic to uni, eggs, or other seafood, or do not want to eat raw seafood, please do not participate.

For more information e-mail: Consumerstest@umit.maine.edu or call 207.581.1733.

Test Kitchen and Consumer Testing Center
University of Maine Food Science and Human Nutrition

- Fresh uni was extracted 30 minutes before panel started and kept chilled

left to right

Cultured urchins fed Nofima (968)

Cultured urchins fed dried mixed kelp in Platter tank (673)

Captured urchins fed dried mixed kelp in Platter tank (726)

Freshly harvested top quality wild urchins (395)

- Tasters did not know origin
- Scored on computer
- Scores analyzed with SIMS Sensory Evaluation Software

Flavor Attributes

sweet
salty
bitter
acidic
savory (umami)
fishy

Overall Attributes

Color
Appearance
Flavor
Firmness
Overall

Flavor Attributes

	sweet	salty	bitter	acidic	savory	fishy
Cultured, dried kelp Platter tank	28.9%	39.5%	42.1%	5.3%	26.3%	47.4%
Captured, dried kelp Platter tank	42.1%	42.1%	18.4%	10.5%	28.9%	52.6%
Cultured, Nofima diet V-trough	21.1%	21.1%	44.7%	5.3%	42.1%	26.3%
Freshly harvested wild	76.3%	31.6%	2.6%	0%	47.4%	36.8%

- Scored as either yes or no
- Freshly harvested wild urchins had highest scores for desirable sweet and savory attributes and lowest score for undesirable bitter
- Cultured urchins scored poorly for sweet and bitter, regardless of whether they were fed dried kelp or Nofima
- However, cultured urchins fed Nofima diet had improved umami scores
- Captured urchins fed dried kelp were sweeter and less bitter than cultured urchins fed dried kelp, but both groups lacked umami (savory)

Overall Attributes

	color	appearance	flavor	firmness	overall quality
Cultured, dried kelp Platter tank	5.5^{b}	5.32^{b}	5.24^{b}	5.92^{ab}	5.24^{b}
Captured, dried kelp platter tank	5.32^{b}	5.74^{b}	5.87^{ab}	6.18^{ab}	5.82^{ab}
Cultured, Nofima diet V-trough	6.87^{a}	6.03^{ab}	5.74^{b}	5.55^{b}	5.68^{b}
Freshly harvested wild	7.11^{a}	7.05^{a}	6.89^{a}	6.84^{a}	6.89^{a}

- 9 point scale, 5=neither like nor dislike
- Freshly harvested wild urchins were preferred in all categories
- For color and appearance, cultured urchins fed Nofima were liked as much as freshly harvested wild urchins
- For flavor, firmness and overall quality, captured urchins fed dried kelp were liked as much as freshly harvested wild urchins

Conclusions

- Consumers liked freshly harvested wild urchins better than aquacultured urchins
- Cultured urchins fed Nofima had gonad yields (33%) that were significantly higher than kelp-fed or wild urchins
- The Nofima diet produced gonads in cultured urchins with yields, color, appearance, and umami similar to wild urchins
- However, cultured urchins were more bitter and less sweet than wild urchins whether they were fed Nofima or dried kelp
- Mixed dried kelp improved yields and flavor in wild urchins captured for gonad enhancement

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