November 27th, 2007

NOSB Symposium on Organic Net Pen Standards

Washington, D.C.

KONA BLUE™

KONA BLUE WATER FARMS

By: Neil Anthony Sims, M.Sc. President, Kona Blue email: neil@kona-blue.com

Applicability of Organic Principles to Marine Finfish Culture

Comparing Open Ocean Net Pens to Closed-Containment Systems for Production of Kona Kampachi® (*Seriola rivoliana*)

Presentation by:
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INTRODUCTION :

- The McCarthyism of Mariculture
- The *Salmo*-centricity of the debate
- The historical arc of net pen farming of marine fish

METHODS :

- Comparing land-based tank culture with open ocean net pens

RESULTS :

1. Biological loading and stocking densities
2. Effluent fate and nutrient recycling
3. Energy usage and carbon footprint differential
4. Other considerations: animal welfare and ecosystem impacts

DISCUSSION

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MORALLY QUESTIONABLE :

Scaring America fishless

Mozaffarian and Rimm, 2006, JAMA

36% reduction in coronary death

17% reduction in overall mortality

DISTORTION :

Use past poor examples to deride Organic farming aspirations

"Plumes of sewage" analogies

Feed lots? Net pens in oceans = Fences on land

Portrayal of Organic principles as ideal, rather than *an* ideal

OUTRIGHT LIES :

Testimony to NOSB asserting Kona Kampachi® FCR of 50 : 1

INTRODUCTION :

• The *Salmo*-centricity of the debate

MARINE FISHES :

20,000 species

Terrestrial agriculture – 10,000 years

Marine fish culture – 30 years

DIVERSE ECOSYSTEMS AND SPECIES :

Mediterranean – Seabass, seabream

SE Asia – Mullet, milkfish, groupers, snappers

China, Korea Japan - hamachi, bream, groupers, snappers

Norway, Scotland – Cod, flatfish

Spain – Seabass, seabream, turbot

Caribbean - Cobia

Hawaii – Kona Kampachi®, Threadfin moi

INTRODUCTION :

• The historical arc of net pen farming of marine fish

EARLIEST NET PEN SYSTEMS :

Engineering, siting limitations

Poor feed technology, fish nutrition

Rampant use of prophylactic antibiotics

Little understanding of ecosystem impacts, models

IMPROVED CULTURE PRACTICES :

Improved net pen design – more exposed siting

Formulated feeds – greater digestibility, reduced effluent

Preventative fish health strategies, vaccines

Sophisticated ecosystem modeling

INTRODUCTION :

• The historical arc of net pen farming of marine fish

KONA BLUE :

Exemplar of environmentally-sound open ocean fish farming:

Native species, hatchery-reared

Siting, monitoring

Sustainable feeds

Healthful product

Native species, hatchery-reared

Kona Kampachi™ … *Seriola rivoliana*

- Native deepwater species
- No commercial fishery
- Amenable to hatchery culture
- Excellent growth rates
- Highly efficient feed conversion ratios

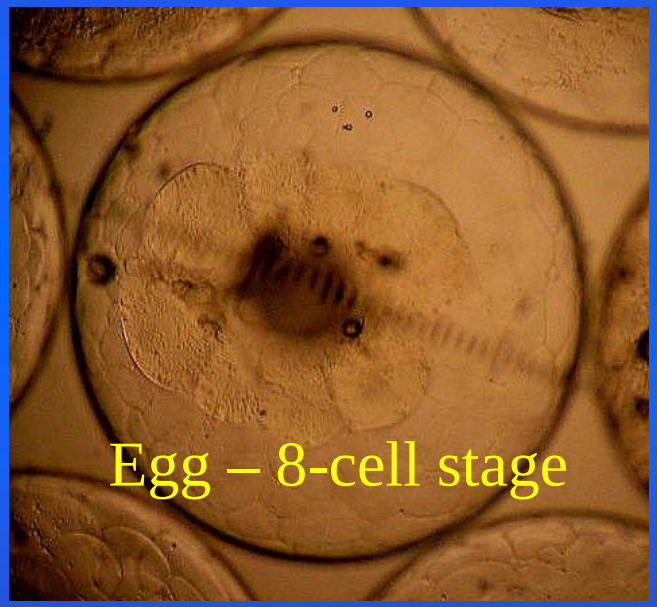
Tastes great: Superb sashimi Versatile cooked fillets

KONA KAMPACHI™

www.kona-kampachi.com

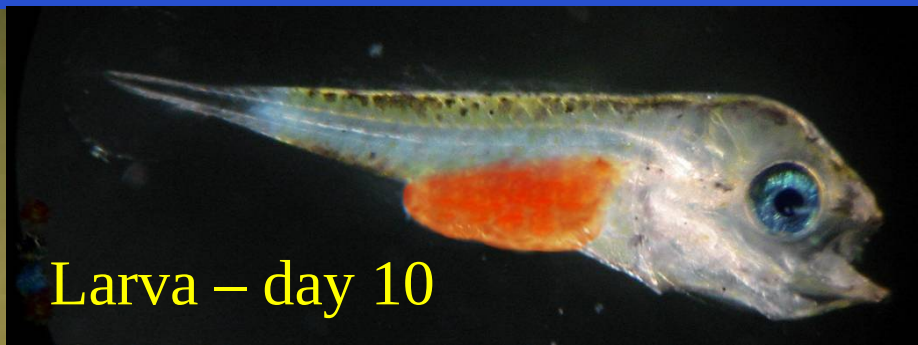
Native species, hatchery-reared

Hatch-to-harvest … The key to sustainability… and quality


Egg – 8-cell stage


Egg – late embryo


Larva – day 1


Larva – day 10

Native species, hatchery-reared

Fingerlings, Day 20

Hatch-to-harvest …

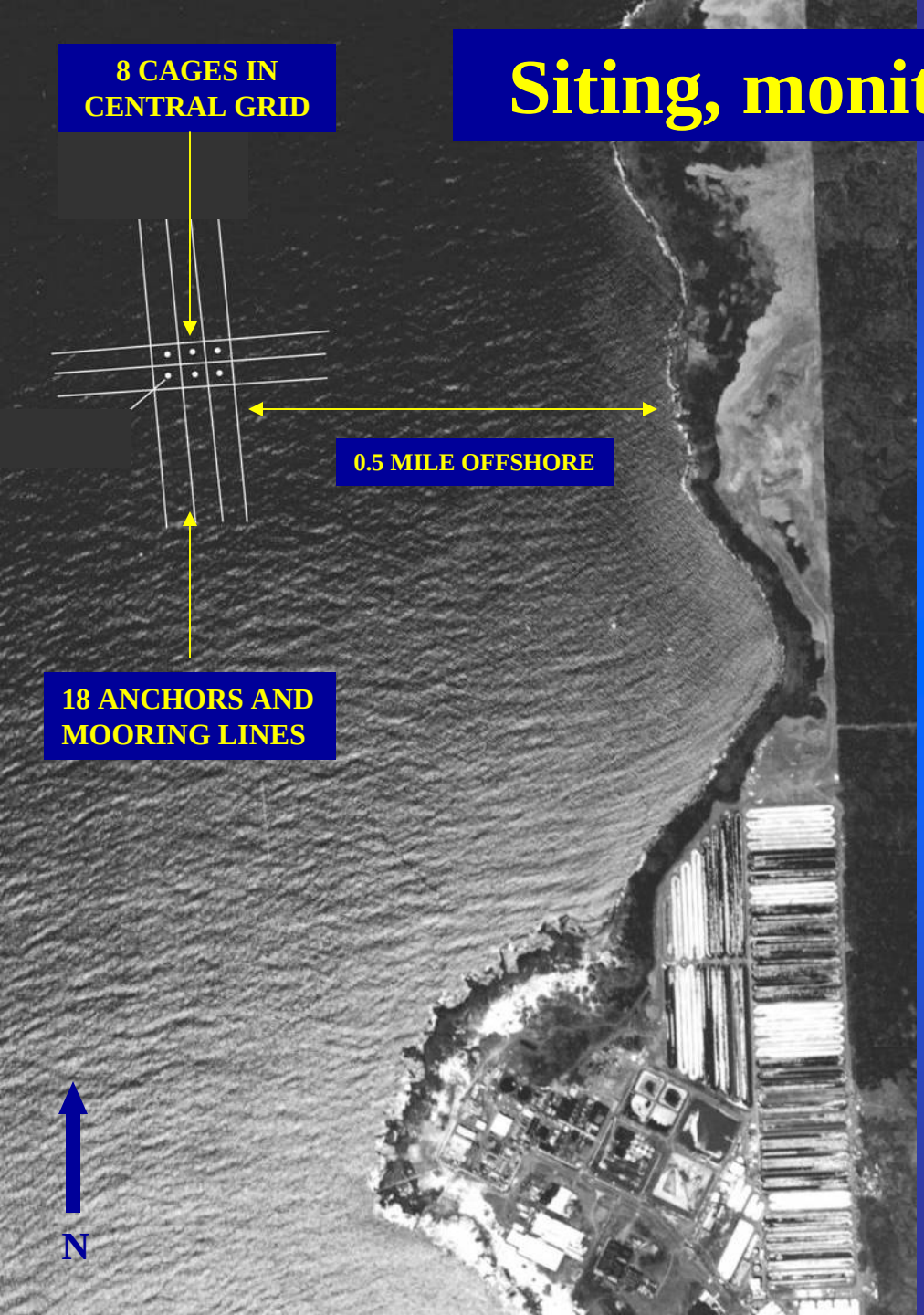
The key to sustainability …

… and quality

Nursery culture
Day 30 – Day 60

Fingerlings, Day 30

Siting, monitoring



Kona Blue open ocean farm site :

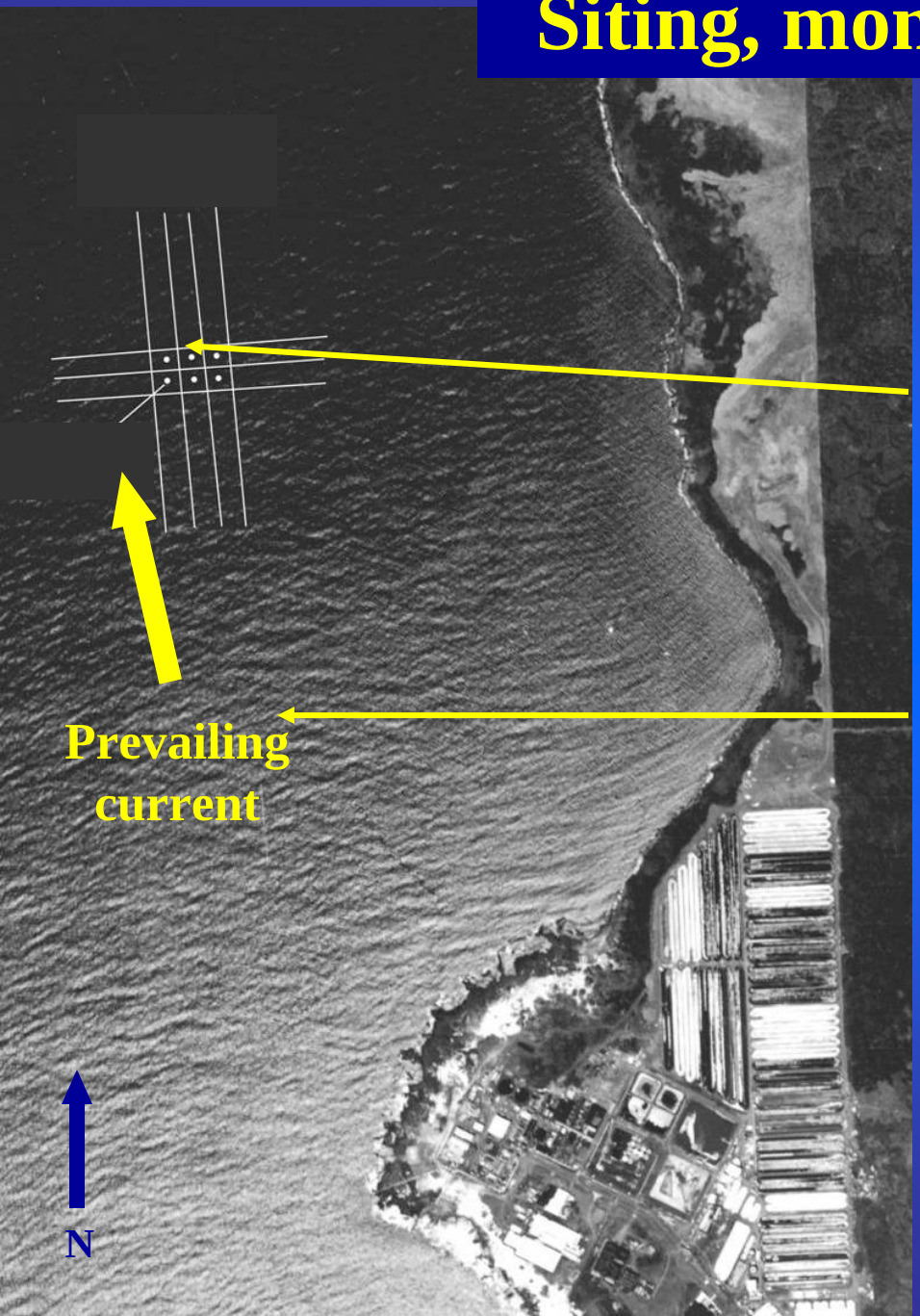
1. 200 - 220 ft of water
2. 2600 ft offshore (0.8 km)
3. Outside of fishing grounds
4. Beyond diving range
5. Clear of fringing reef
6. Strong currents
7. Sand bottom

KONA KAMPACHI™
www.kona-kampachi.com

Siting, monitoring

Feeding is always actively monitored (by in-cage video cameras, or divers) to ensure no wasted feed falls through the cage

Siting, monitoring



Kona Blue water quality monitoring sampling sites :

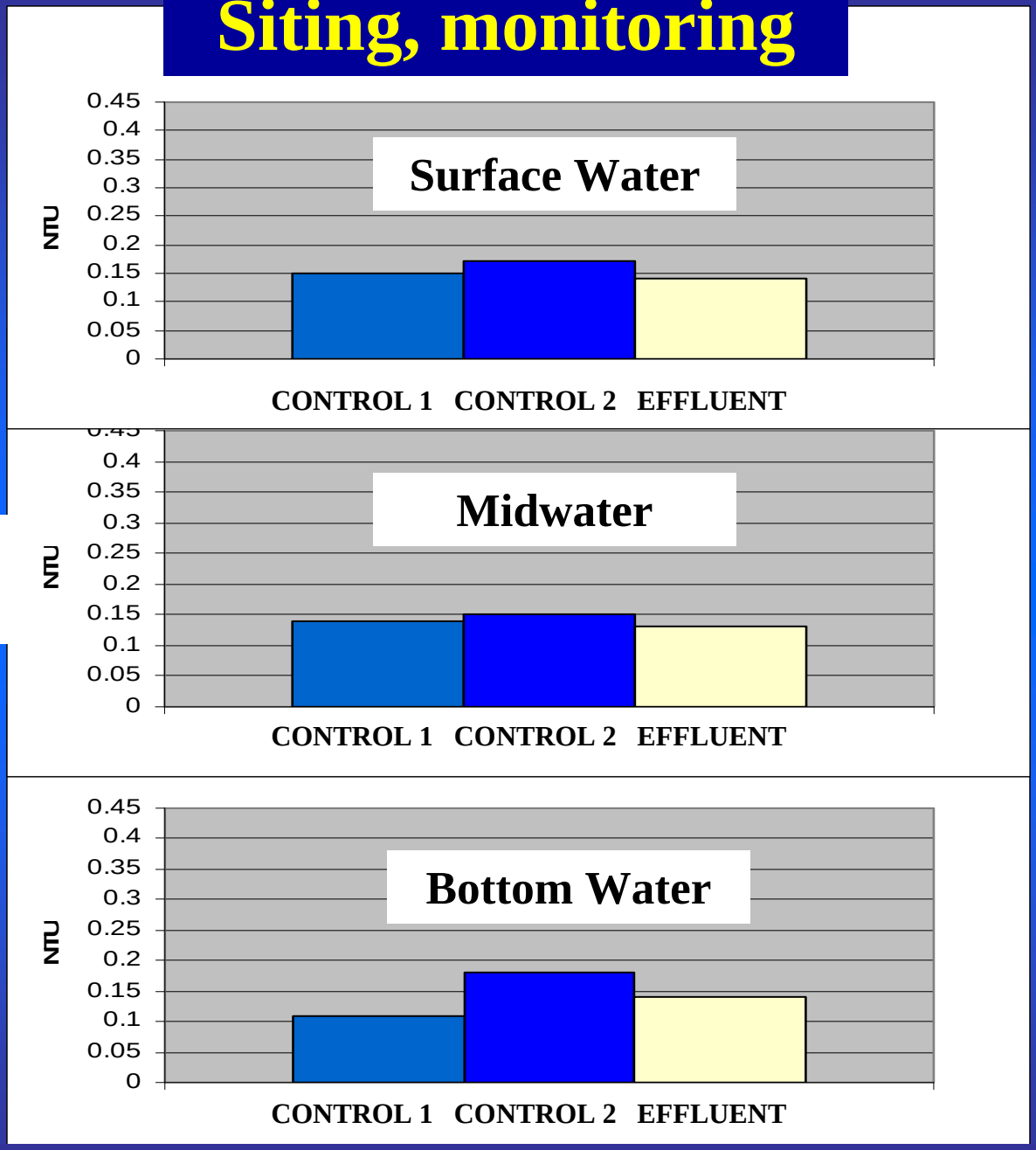
Effluent site: Immediately downcurrent of the cage with highest biomass, one hour after feeding

Control site: Upcurrent of the cages

KONA KAMPACHI™
www.kona-kampachi.com

Siting, monitoring

TURBIDITY (NTUs)



No detectable environmental impacts at any level of significance

Sustainable feeds

50% vegetarian - agricultural grain products

Soy meal, canola, wheat gluten, corn gluten

Fishmeal / fish oil from sustainable fisheries

10% meal from edible seafood trimmings

Goal of zero meal from reduction fisheries

BC hake trimmings, poultry meal

Healthful product

- **Fish diet controlled from hatch-to-harvest**

- **No risk of internal parasites or ciguatera**

(such as found in wild kahala)

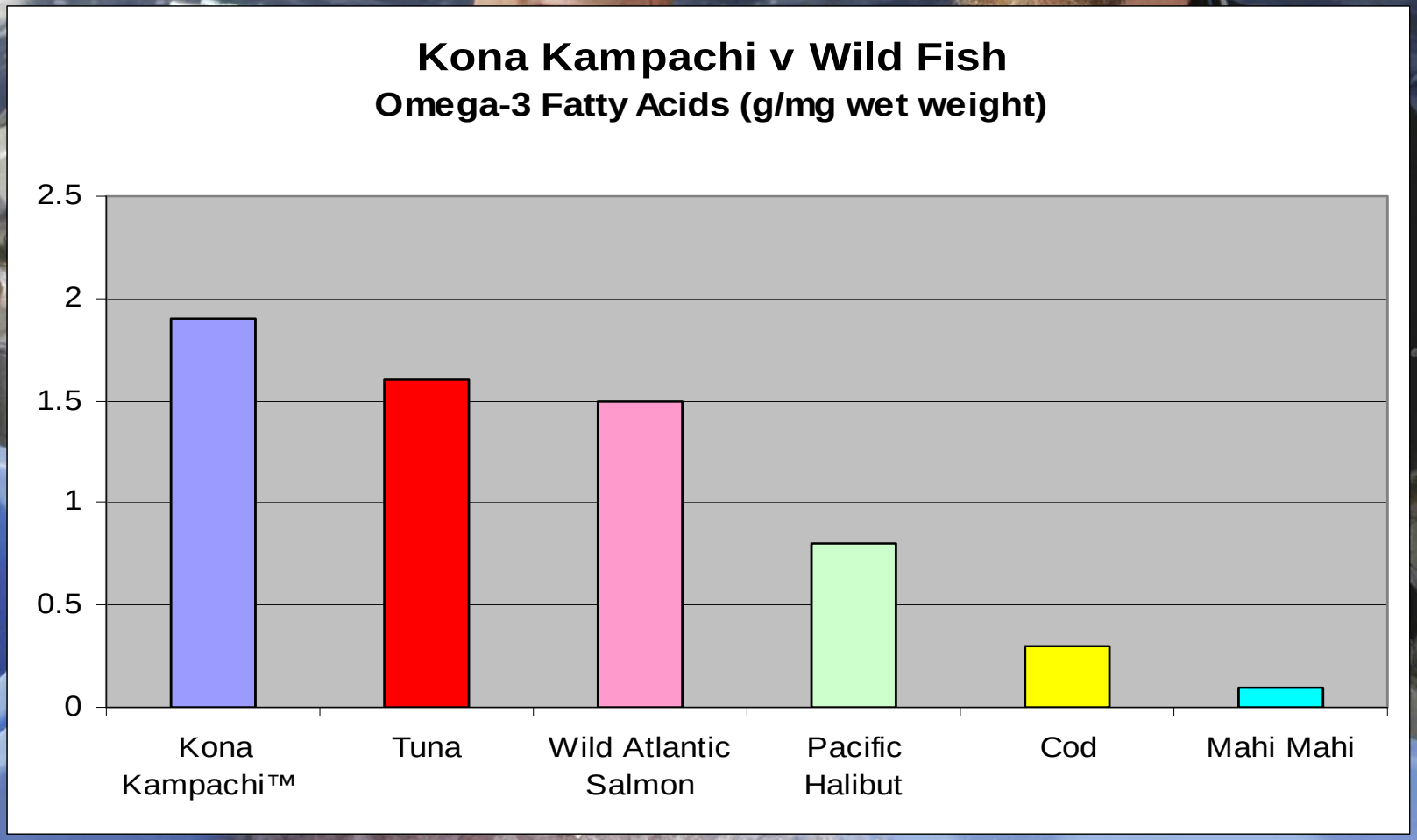
- **Undetectable levels* of Mercury**

(* = at sensitivity levels of 50 times FDA's allowable limits)

Healthful product

Fat levels of over 30 % (dry weight)

Heart-healthy omega-3 fatty acids higher than almost any other fish (e.g. mackerel, sardines, tuna)



Healthful product

Now harvesting over 18,000 lbs per week.
On track to be harvesting 30,000 lbs / week by mid 2008.

The exemplar of all that ocean culture could be ….

….and should be!

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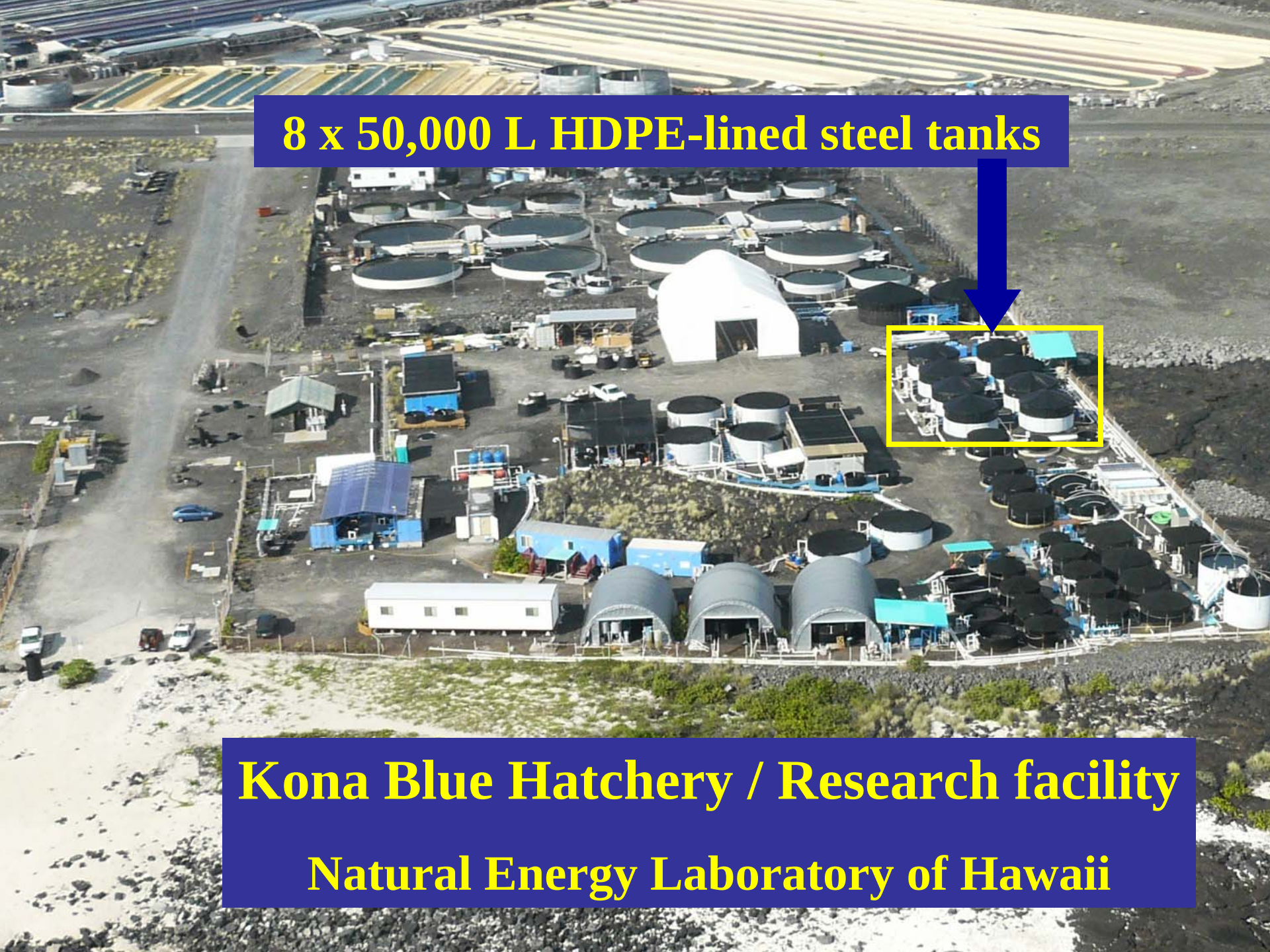
RESULTS :

1. Biological loading and stocking densities
2. Effluent fate and nutrient recycling
3. Energy usage and carbon footprint differential
4. Other considerations: animal welfare and ecosystem impacts

DISCUSSION


8 x 50,000 L HDPE-lined steel tanks
Kona Blue Hatchery / Research facility
Natural Energy Laboratory of Hawaii


Eight submersible SS3000s now on site.
The cage usually lies 30 ft below the surface, submerged in the “silent world”.
© Doug Perrine / SeaPics.com

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1. Biological loading and stocking densities

	LAND-BASED TANKS	OPEN OCEAN NET PENS
Construction	Steel frame with HDPE liner, PVC pipe and drains	Sea Station™ steel frame on Kevlar® netting
Number of units	Eight (8)	Eight (8)
Unit volume	25 cubic m	3,000 cubic m
Total capacity	200 cubic m	24,000 cubic m
Mean density	25 kg/m^3	15 kg/m^3
Standing stock	5,000 kg	360,000 kg
Water exchange	0.25 turnovers /hr	60 turnovers /hr
Flow-rate (L/hr)	6,250	720,000,000
Loading (Kg/L/hr)	0.8	0.0005
Production capacity	10,000 Kg/yr	720,000 Kg/yr

1. Biological loading and stocking densities

LAND-BASED TANKS

OPEN OCEAN NET PENS

1,600 x greater biological loading

67% greater max. fish density

Heavy shade (90% shadecloth)

Constant centripetal current

Fish in close contact with tank floor – feces, fouling

Fish held in one position, oriented into current

Low density, high exchange

Closer to natural environment

Natural lighting, seasons

Natural tides and currents

Net > 100 ft above substrate

Fish swim freely, individually or schooling together

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2. Effluent fate and nutrient recycling

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2. Effluent fate and nutrient recycling

LAND-BASED TANKS

Effluent to dispersion wells, feeds nearshore groundwater

1,600 times more concentrated

No detectable plume

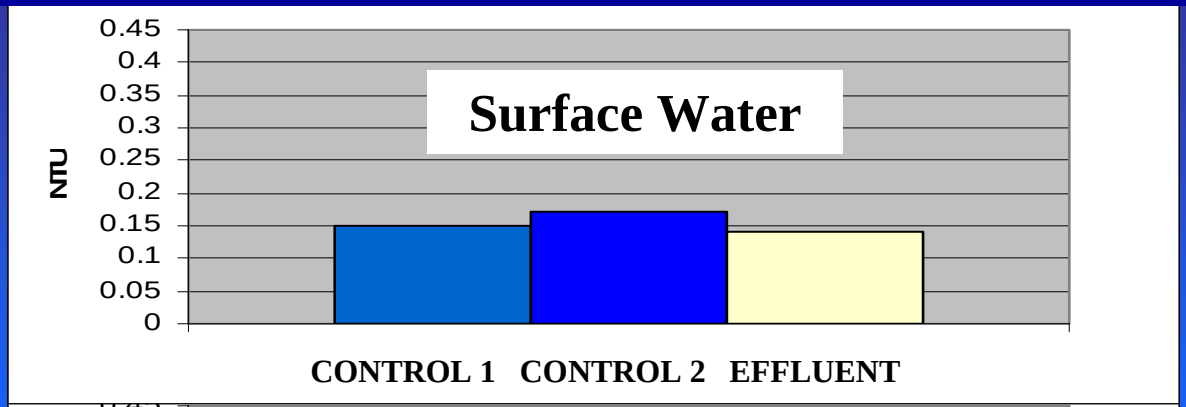
No measureable impact on groundwater or nearshore waters

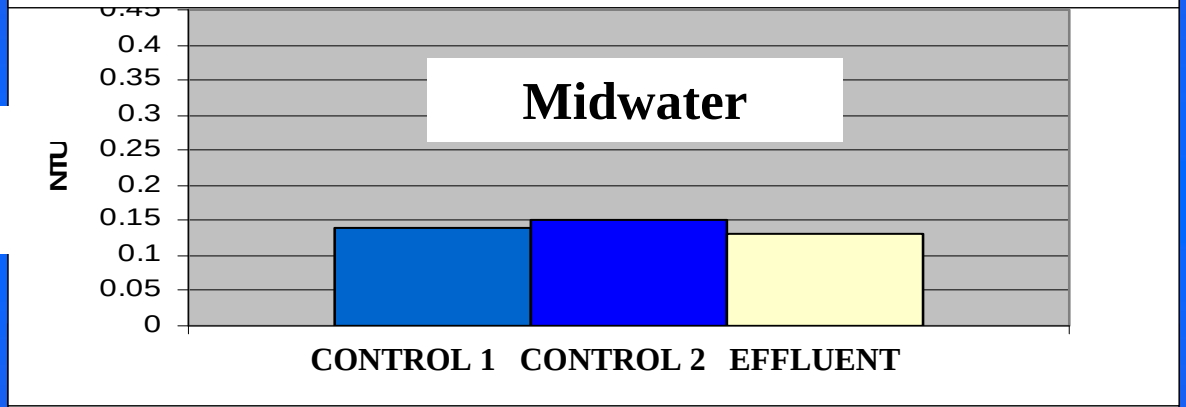
Water quality data available at local repository and at www.kona-blue.com

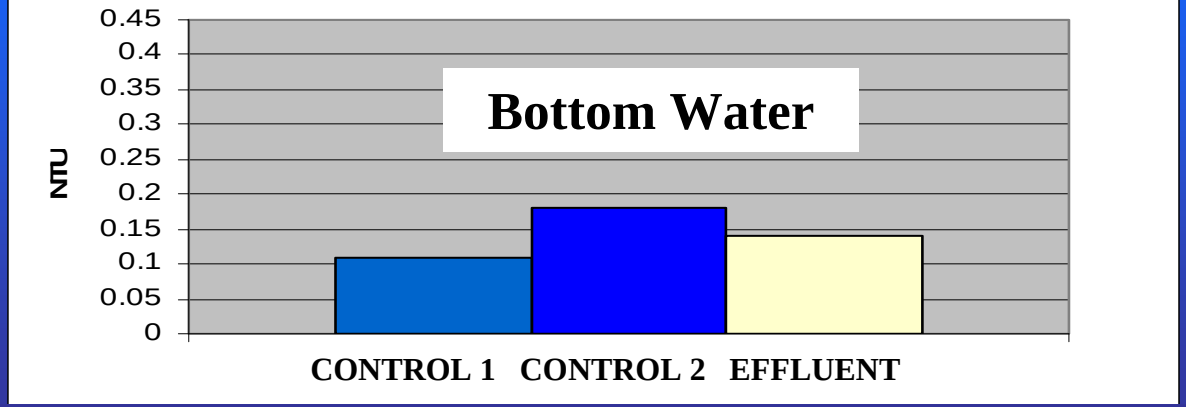
No measurable impact on effluent water quality

2. Effluent fate and nutrient recycling

TURBIDITY (NTUs)







No detectable environmental impacts at any level of significance

2. Effluent fate and nutrient recycling

LAND-BASED TANKS

At scale, possible nutrient impacts on groundwater, coral reef

Particulates / solids salt-laden, not recyclable

Potential increased benthic algae or filter feeder growth

Nutrient enrichment in groundwater or nearshore waters = pollution

OPEN OCEAN NET PENS

Expansion across current, effluents not additive

Sited to retain particulates in mixed layers of water column

Dissolved nutrients quickly assimilated, bioavailable

Nutrient enrichment to oligotrophic ocean waters = productivity

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3. Energy usage and carbon footprint

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3. Energy usage and carbon footprint differential

LAND-BASED TANKS

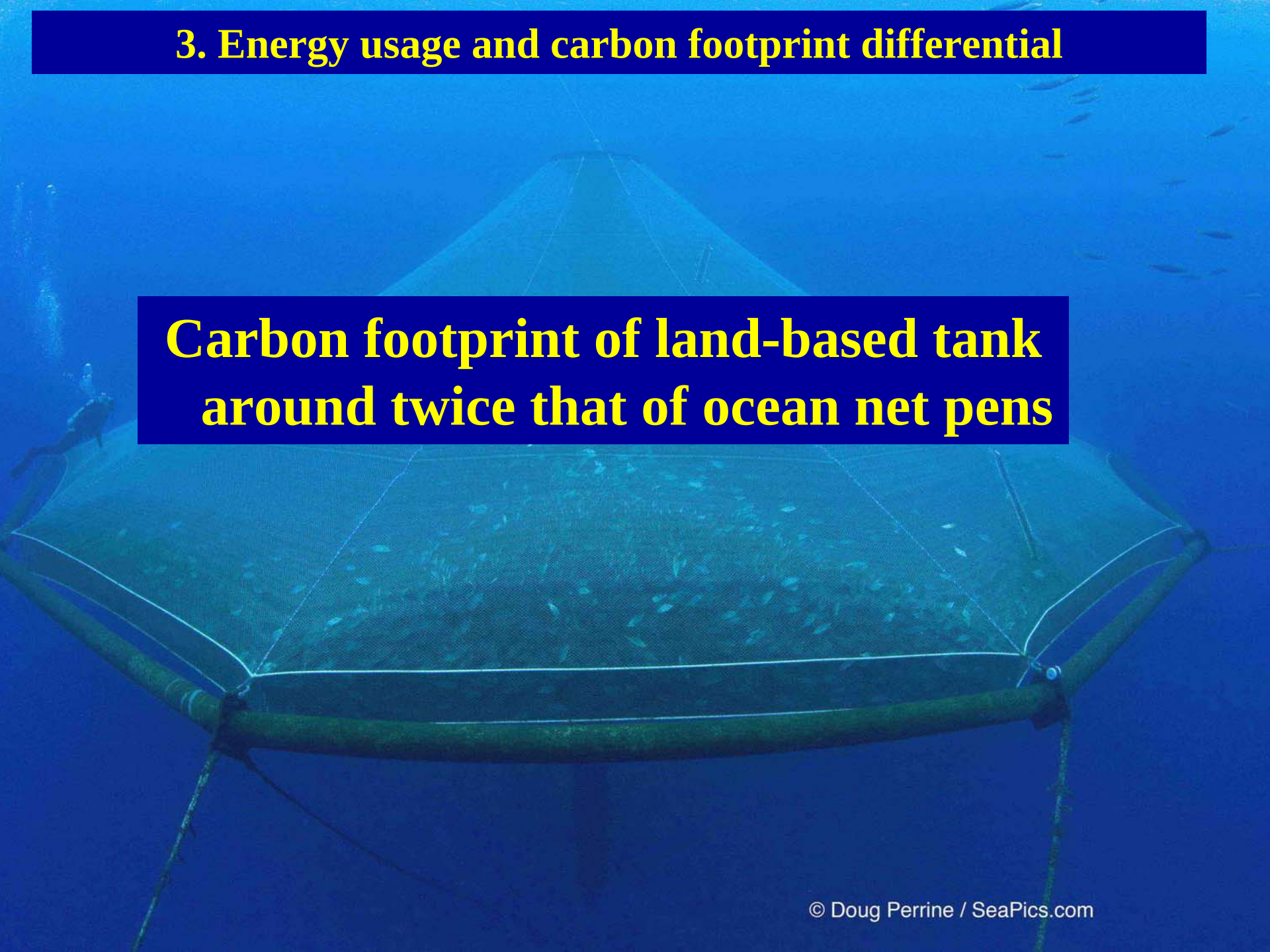
Pump head (lift)	5	m
Pump volume	6,250	L/hr
Pump draw	0.42	Kw.hrs/Kgals
Electricity demand	64	Kw.hrs/day
CO_2 Production by electricity generation	0.55	lbs / Kw.hr
Annual carbon footprint	5.7	Tonnes CO_2 /yr
Annual production capacity	10,000	Kg/yr
Kona Kampachi® production demand	1,743	Kg / T CO_2

3. Energy usage and carbon footprint differential

OPEN OCEAN NET PENS

Distance from harbor to site	8	km
Average vessel round trips	2.5	per day
Average time per round trip	1.5	Hrs
Average vessel power	500	Hp
Diesel consumption	50	Gallons/day
CO2 Production by diesel engines	22.4	lbs/gal
Annual carbon footprint	200	Tonnes CO2 /yr
Annual production capacity	720,000	Kg/yr
Kona Kampachi® produced	3,586	Kg / T CO2

3. Energy usage and carbon footprint differential



Carbon footprint of land-based tank around twice that of ocean net pens

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4. Animal welfare and ecosystem impacts

Ongoing monitoring wild conspecifics near Kona Blue site

***Caligus*-like parasites: highly prevalent - 12 / wild fish**

***Neobenedenia* sp (skin flukes): very scarce - 0.22 flukes / wild fish**

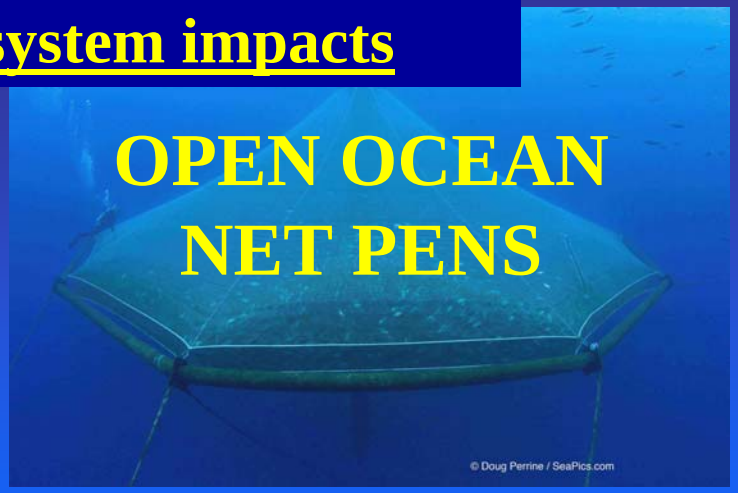
Wild fish heavily laden with internal parasites

No internal parasites in cultured Kona Kampachi®.

No evidence of any negative pest or parasite interaction between farmed and wild fish

4. Animal welfare and ecosystem impacts

LAND-BASED TANKS



Kona Blue's standards for "environmentally sound aquaculture"

Local species, healthy wild stocks

No broodstock beyond F2

Sea Station™ and Aquapod™ cages resistant to predators

Predator Management Plan - progressive farm management

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Benefits of Organic fish farms

Ecosystem impacts can be beneficial – provided farm is carefully sited and appropriately scaled (Rensel and Forster, 2007)

Fish farm can become productivity pump - base for a trophic pyramid

DISCUSSION

No detrimental impacts … Consider:

Hypothetical open ocean fish farm in mid-Atlantic Ocean

Can impacts be considered negligible?

If not … why not?

If so, then why not Organic?

DISCUSSION

1. How can open cage net pens be ecologically responsible?
What requirements needed in the proposed regulation to assure this?
How can issues of water flow and rotational locations be included?
What are the other issues?

Three critical factors :
the species cultured, the biomass, and the site

Overarching aspiration of Organic net pens :
operate within ecosystem capacities

Establish standards, and then *monitor*

DISCUSSION

2. Sea-lice: What is prevalence of sea lice infestation …where no net pens?

Are sea lice infestations inherent with open cage net pen systems?

Can they be controlled without prohibited substances in organic system?

AWG's recommendation: "Facility managers shall take all practicable measures to prevent transmission of diseases and parasites between cultured and wild aquatic animals."

Suggest also "Monitoring shall be employed to ensure that wild conspecifics or other wild fish are not subject to harmful disease or parasite burdens originating from proliferation within the facility"

Establish standards, and then *monitor*

DISCUSSION

4. Assimilation of waste: How much can any system expect to mitigate waste in outflow and settling of waste in open pen systems?

AWG : "Aquaculture facilities shall be designed and operated to minimize the release of nutrients and wastes into the environment."

"Aquaculture facilities shall be designed and operated to minimize the release of, or – in the case of open net pen culture - optimize the assimilation of nutrients and wastes into the environment."

DISCUSSION

4. Assimilation of waste: How much can any system expect to mitigate waste in outflow and settling of waste in open pen systems?

AWG : "Metabolic products of one species are recognized as organic resources for one or more other species in an aquaculture production system."

"… organic resources for one or more other species in an aquaculture production system or in the wider aquatic ecosystem ."

DISCUSSION

4. Assimilation of waste: How much can any system expect to mitigate waste in outflow and settling of waste in open pen systems?

AWG : "Open water net-pens and enclosures are permitted where water depth, current velocities and direction, stocking densities, and other factors act to adequately disperse metabolic products in order to minimize accumulation of discharged solids on the bottom sediments under the net pens. … Monitoring shall be employed to ensure that the natural assimilative capacity at the site is not overburdened ."

Establish standards, and then *monitor*

DISCUSSION

4. Assimilation of waste: How much can any system expect to mitigate waste in outflow and settling of waste in open pen systems?

AWG : "Use of multiple species of aquatic plants and animals to recycle nutrients must be included in every management plan."

Inappropriate for offshore …
Instead, encourage more exposed sites

DISCUSSION

5. Predators: What is the risk to and from predators in open pen systems?

In relation to language in the AWG document, in what ways is the section on predators adequate, or in need of changing, etc?

Taut mesh on open ocean net pens renders them largely immune to predators

Predator Management Plan –
allows for improvement and adaptation

DISCUSSION

6. Migratory issues: How is migration a valid issue for these fish at the stage of life when they would be housed in open net pen systems? If so, what are these issues and their implications?

Is there residual migratory instinct in cultured fish?

Perhaps for anadromous parents or F1s
Not for marine fish … not for 'domesticated' fish

CONCLUSIONS

Closed-containment systems are further from the ideals of Organic aquaculture

Fish densities

Effluent fate / nutrient recycling

Exposure to natural systems

Energy use

CONCLUSIONS

The question is not whether net pen culture should be allowable as Organic, but rather, how standards should be established to comply with Organic principles.

Establish siting guidelines

Establish standards, and then *monitor*

CONCLUSIONS

good for the fish

good for the oceans

good for humanity

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