



Saltwater pen rearing



Use of feed chart, calculating feed amounts

EWOS Canada Ltd.

Recommended Feeding for Pacific Salmonids

EWOS micro, transfer, smolt, alpha, pacific and vita

Enh - Pacific 02-00

Feeding rates (% biomass / day) for fish size ranges (in grams and fish per pound) as follows

EWOS Feed		EWOS micro			micro, smolt & pacific	EWOS transfer, smolt, alpha, pacific and vita*									
		#0	#1	#2		(*EWOS vita is not available as a 1.5mm short-cut pellet)									
Feed Size		#0	#1	#2	1.2 mm	1.5 mm short-cut	1.5 mm	2.0 mm			3.0mm				
Min. Fish Weight grams		0	0.2	1.5	3	5	12	25	40	50	80	110	150	200	
<i>Minimum fish per pound</i>			2270	302	151	91	38	18	11	9	6	4	3	2.5	
Max. Fish Weight grams		0.2	1.5	3	5	12	25	40	50	80	110	150	200	250	
<i>Maximum fish per pound</i>		2270	302	151	91	38	18	11	9	6	4	3	2.5	2	
WATER TEMPERATURE Celsius & Fahrenheit	1 - 2	34-36	1.07	1.03	0.99	0.95	0.79	0.72	0.67	0.64	0.61	0.44	0.25	0.18	0.14
	2 - 3	36-37	1.30	1.19	1.12	1.08	1.02	0.93	0.82	0.78	0.74	0.56	0.37	0.24	0.22
	3 - 4	37-39	1.70	1.36	1.26	1.25	1.23	1.12	1.00	0.96	0.94	0.72	0.49	0.35	0.29
	4 - 5	39-41	1.85	1.49	1.38	1.34	1.32	1.26	1.14	1.11	1.09	0.89	0.62	0.43	0.36
	5 - 6	41-43	2.00	1.62	1.51	1.45	1.40	1.35	1.23	1.20	1.19	0.98	0.71	0.52	0.43
	6 - 7	43-45	2.11	1.72	1.56	1.49	1.44	1.39	1.28	1.28	1.23	1.06	0.80	0.62	0.54
	7 - 8	45-46	2.22	1.86	1.64	1.56	1.51	1.44	1.36	1.33	1.28	1.14	0.95	0.77	0.65
	8 - 9	46-48	2.41	2.11	1.80	1.64	1.60	1.48	1.44	1.38	1.36	1.22	1.05	0.84	0.72
	9 - 10	48-50	2.61	2.40	1.94	1.73	1.67	1.56	1.50	1.44	1.41	1.28	1.14	0.88	0.78
	10 - 11	50-52	2.78	2.59	2.06	1.84	1.76	1.63	1.56	1.48	1.46	1.33	1.24	0.94	0.86
	11 - 12	52-54	2.93	2.78	2.23	1.95	1.85	1.71	1.61	1.54	1.51	1.44	1.30	1.03	0.93
	12 - 13	54-55	3.13	2.97	2.40	2.16	2.01	1.80	1.67	1.58	1.53	1.50	1.36	1.12	1.02
	13 - 14	55-57	3.29	3.16	2.58	2.38	2.18	1.83	1.72	1.64	1.58	1.53	1.42	1.14	1.03
	14 - 15	57-59	3.45	3.35	2.84	2.59	2.43	1.95	1.78	1.73	1.69	1.56	1.48	1.15	1.05
15 - 16	59-61	3.56	3.49	2.96	2.72	2.44	1.95	1.78	1.71	1.64	1.53	1.48	1.11	0.99	
16 - 17	61-63	3.07	3.03	2.49	2.30	2.10	1.77	1.62	1.55	1.49	1.43	1.29	0.93	0.83	

The above figures are meant as a recommendation only, actual feeding rates will vary by site and species.

Calculate amount to feed

1. 3,000,000 chum at 0.50g / feed rate = 2%
2. 200,000 coho at 12g / feed at 2.4%
3. 300,000 chinook fry at .45g / feed at 3.2%

Medications added to feed

- TM200 = ?g active oxytetracycline/pound (454g)
- Standard dosage of oxytetracycline = 3.75g active/100# fish/day x 28 days

Example:

- 200,000 coho @ 10g; feed rate = 2% body wt/day
 - Calculate biomass to treat
 - Calculate amount of active OTC/day
 - Calculate amount of TM200/day
 - Calculate amt of feed/day
 - Calculate %TM200 in feed/day

Bonus questions if you want to make up some points – Assignment “11”

FT222

April 14, 2015

Optional work on feeding calculations

5 points for each example

1. 3,000,000 chum fry @ .48g; water temp is 5C; find:
 - a. Biomass (kg)
 - b. Daily feed rate (use EWOS feed chart)
 - c. Daily amount to feed (kg)
 - d. What size feed?

2. 200,000 coho fingerlings @ 10g; water temp is 9C; find:
 - a. Biomass (kg)
 - b. Daily feed rate (use EWOS feed chart)
 - c. Daily amount to feed (kg)
 - d. What size feed?

3. 84,000 chinook fingerlings at 5g; water temp is 7C; find:
 - a. Biomass (kg)
 - b. Daily feed rate (use EWOS feed chart)
 - c. Daily amount to feed (kg)
 - d. What size feed?

Spring and Fall Transfer to Saltwater

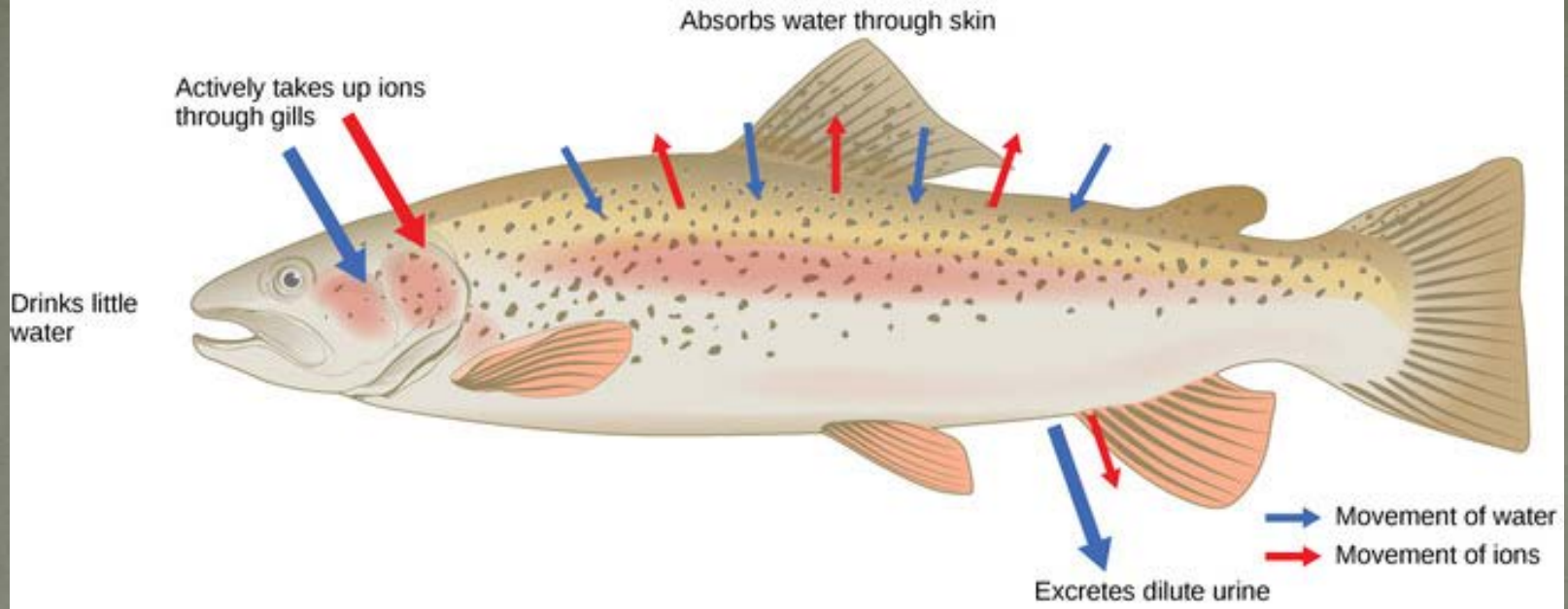
- Osmotic Balance
 - If they go into to a seawater pen before they are ready they simply become dehydrated and die! It sucks the life out of them.



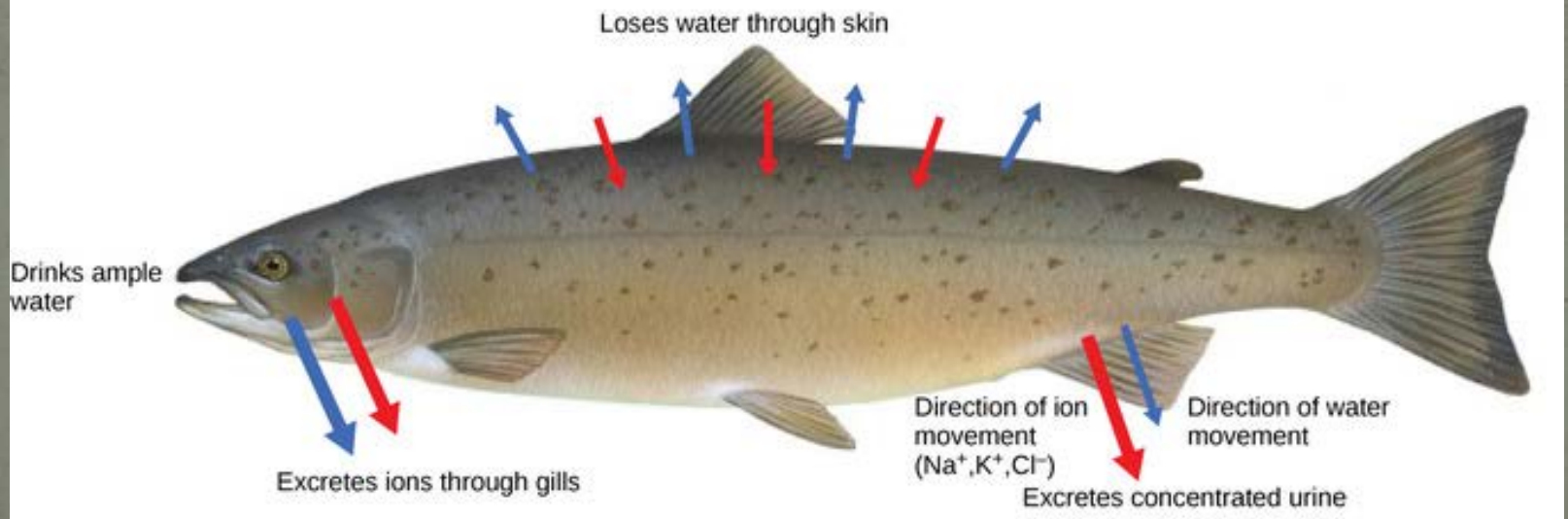
Osmo-Regulation & Smoltification

- The body fluids of salmon are not the same as the water they swim in.
- Essentially the only thing that separates the fluid on the inside of the fish and the surrounding environment are the gills.
- The gills are not protected from the water and are constantly permeable to dissolved nutrients in the water.
- There is always a concentration gradient present for some substances present in the fish's blood and tissue (Na, K, Cl).
- The transformation from a parr to smolt is a process that allows the fish to adapt (osmoregulate) in rapidly changing salinities.

(Physiology Of Fish In Intensive Culture Systems, Wedemeyer 1996)

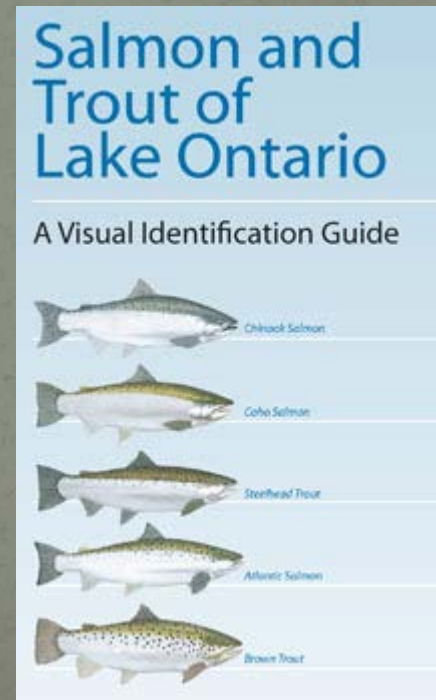


(a) Osmoregulation in a freshwater environment



(b) Osmoregulation in a saltwater environment

- Pink and chum fry can adapt to seawater at a very young age
- Chinook, coho, sockeye generally need one year in fw
 - Plenty of exceptions!
 - All can be found landlocked in some areas
 - All can be found to adapt to seawater in their first year



From *Physiological Ecology of Pacific Salmon*, Groot, Margolis, Clarke

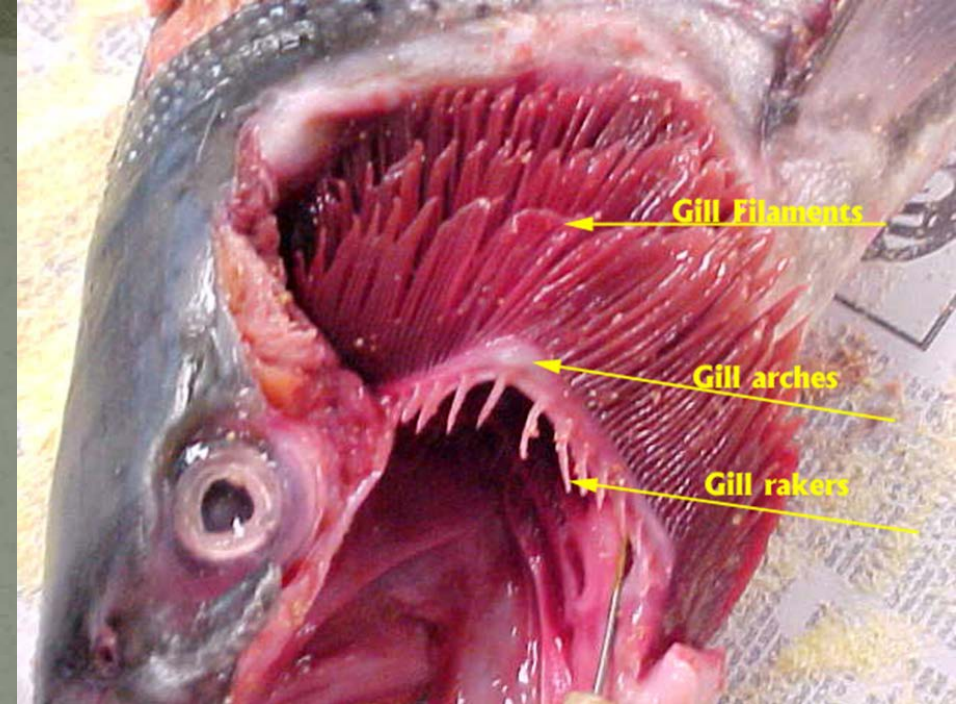
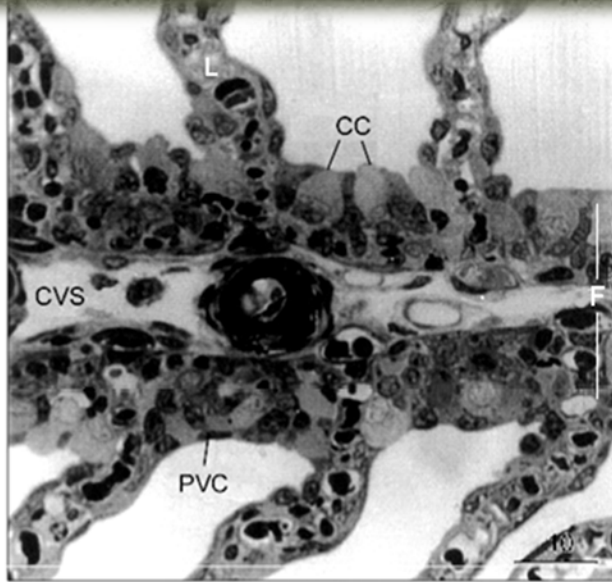
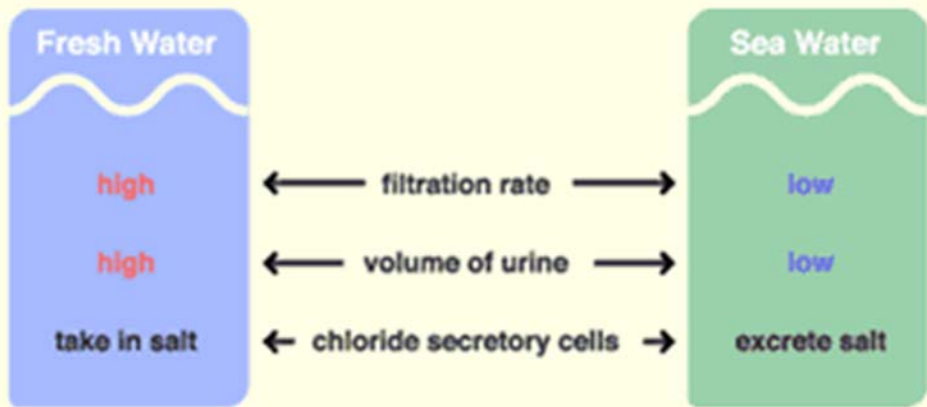


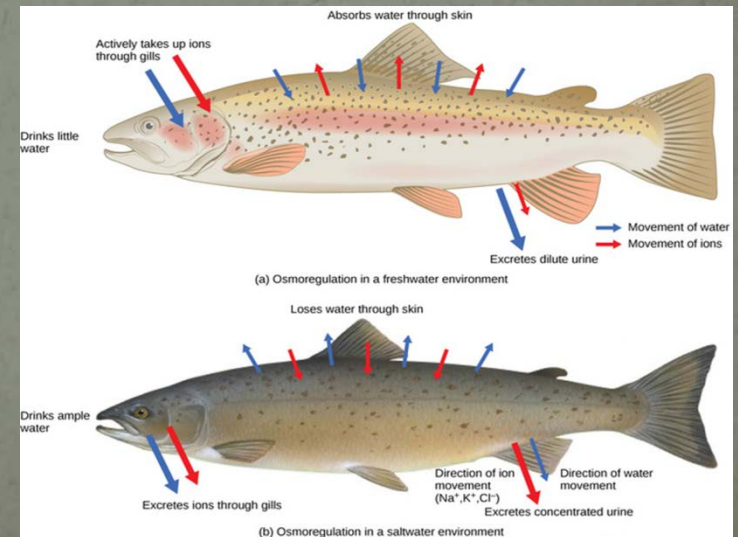
Fig. 1 — Filament (F) and lamellar (L) epithelium of *H. cf. plecostomus*. Semi-thin longitudinal section of gill filament stained with Toluidine blue. CC = chloride cell; PVC = pavement cell; CVS = central venous sinus. Scale bar is in μm .

- Teleost fish have both lamellar and filament epithelia
- Chloride cells reside mostly in the filament epithelia
- We know that chloride cells are fundamental to regulating salt levels in fish in seawater
- Fish need osmotic “balance” – cc’s help retain proper levels



- In saltwater the salinity outside of the fish is much greater than inside
- Fish need to “drink” water and expel excess salts
- Salts are excreted through the gills
- Marine fish excrete 90% less urine than fw – conserving water

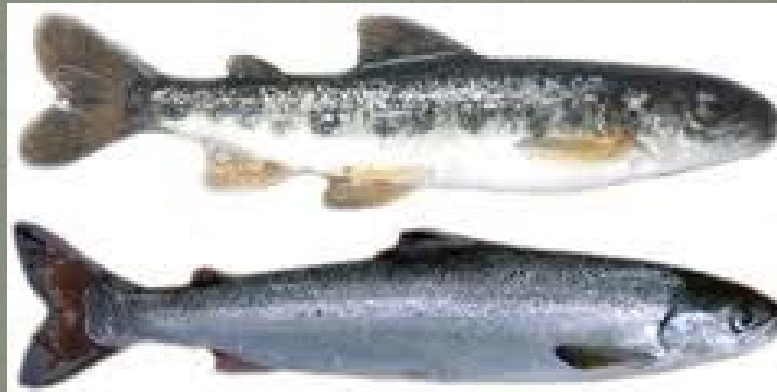
- Intestines absorb water
- Kidneys regulate how much water is excreted



(Physiology Of Fish In Intensive Culture Systems, Wedemeyer 1996)

What variables affect smoltification?

- Daylength – photoperiod
 - Fish are very “seasonal” in their physiological behavior
- Temperature
 - Warmer temps increase growth rate
 - Seasonal changes may stimulate smolting
 - Warmer temps speed up osmotic development rate
- Growth Rate
- Desmolting



(Physiology Of Fish In Intensive Culture Systems, Wedemeyer 1996)

Physiological Changes that Occur During Smolting

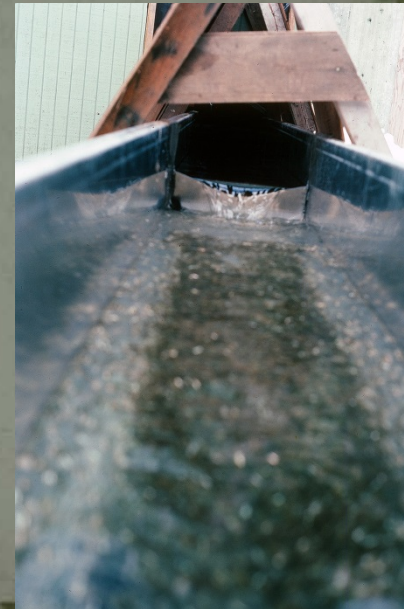
- Migratory Behavior
- Salinity Tolerance
- Body silvering
- Growth rate increases
- Gill ATPase activity

The most obvious change noticed by fish culturists is the activity and coloration



Transfers to Net Pens

- Chums/Pinks
 - Volitional/Non-Volitional
 - Short term freshwater rearing
 - Directly to SWR
 - Must assure they are ready to go! YSP sampling
 - Reared for 2-3 months
 - Sometimes a target size for release
 - Sometimes a target date range
- Cohos
 - Preferably 14gms or larger mid- to late April
 - Usually reared for 3-4 weeks prior to release
- Chinook
 - Late April – bigger is better!
 - Lower 48 and BC have “ocean type”



Feeding and Growth Rates

- Chums/Pinks
 - Short term rearing in saltwater
 - Concerns about outgrowing their houses
 - Feed is ordered well ahead of time and can't be quickly adjusted
 - Some facilities turning to “late/large” with chums
- Coho
 - Mostly fw reared
 - Short term saltwater
 - A typically aggressive feeder
- Chinook
 - Mostly fw reared
 - Short term sw



Feeding and Growth Rates - Chums

- Normally slow start but depends on water conditions
- Very important to present feed frequently and enough so all fish in the pen can see it
- A poor start will result in “pinheads” – feed the entire pen!
- Critical period is between entry - .7gms
- Growth rates as high as 4% are not uncommon in larger fish

BY '01 SUMMER CHUM

SC-1												
SAMPLE DATE	GRAMS /FISH	NUMBER FISH	KG. FISH	MORT	FOOD FED	NO. DAYS	% BODY WT. FED	WT. GAIN	CONVER-SION	%DSGR	DENS.	
01-28-02	0.42	2,199,394	923.75	0	0	0	0.0%	0.00	0.00	0.00	1.36	
02-12-02	0.52	2,196,894	1142.39	2500	290	15	1.9%	218.64	1.33	1.42	1.68	
02-20-02	0.63	2,196,394	1383.73	500	230	23	2.3%	241.34	0.95	2.40	2.03	
02-26-02	0.76	2,195,894	1668.88	500	230	29	2.5%	285.15	0.81	3.13	2.45	
03-08-02	0.93	2,195,394	2041.72	500	425	39	2.3%	372.84	1.14	2.02	3.00	
03-21-02	1.35	2,194,894	2963.11	500	640	52	2.0%	921.39	0.69	2.87	4.36	
03-28-02	1.54	2,194,394	3379.37	500	545	59	2.5%	416.26	1.31	1.88	4.97	
04-12-02	2.08	2,193,394	4562.26	1000	1355	74	2.3%	1,182.89	1.15	2.00	6.71	
04-29-02	3.68	2,191,394	8064.33	2000	1945	91	1.8%	3,502.07	0.56	3.36	11.86	
		2,183,394	0.00	8000	5660	-37284	0.0%	-8,064.33	-0.70	#NUM!	0.00	

Pinks and chums are “thoroughbreds”!



Feeding and Growth Rates - Coho

- Initial feed response might be poor due to fw/sw change
- Entry size for coho smolt varies but around 12-15g
- Rearing site has a great influence on feeding
 - Is there a fw source nearby?
 - What is salinity/temp?
- If fish are fully smolted, feed response should be very good
- Don't make "fat fish"!
- Diet should be high quality to match physiological changes
- Size at release varies – generally around 20g or so
- **Your best asset on any net pen is an experienced fish culturist**



Feeding and Growth Rates - Chinook

- Can be tricky to get started – depending on environment
- Chinook are voracious feeders when smolted and healthy.
- They will generally convert at 1:1 and accept feed at maximum ration in saltwater pens.
- With proper entry timing feeding response will improve quickly after transfer to net pens, usually sooner than coho.

Early rearing:

BROOD YEAR 2011 CRYSTAL CREEK CHINOOK

RW-21											
SAMPLE DATE	GRAMS/ FISH	MORTS	NUMBER FISH	KG. FISH	FOOD FED (KG's)	NO. DAYS	% BODY WT. FED	WT. GAIN	CONVER- SION	%DSGR	DENS.
04-13-12	0.39	619	223,706	87.25	N/A	18	N/A	N/A	N/A	N/A	1.48
04-20-12	0.44	384	223,322	98.26	14	25	2.16%	11.0	1.25	1.72	1.67
04-27-12	0.51	358	222,964	113.71	21	32	2.83%	15.4	1.34	2.11	1.93
05-04-12	0.61	601	222,363	135.64	21	39	2.41%	21.9	0.94	2.56	2.30
05-11-12	0.64	140	222,223	142.22	28	46	2.88%	6.6	4.20	0.69	2.41
05-18-12	0.71	386	221,837	157.50	28	53	2.67%	15.3	1.80	1.48	2.67
05-25-12	0.76	546	221,291	168.18	28	60	2.46%	10.7	2.52	0.97	2.85
06-01-12	0.86	491	220,800	189.89	28	67	2.23%	21.7	1.27	1.77	3.22
06-08-12	0.99	341	220,459	218.25	28	74	1.96%	28.4	0.98	2.01	3.70
06-15-12	1.14	334	220,125	250.94	34	81	2.07%	32.7	1.03	2.02	4.25
06-22-12	1.32	343	219,782	290.11	39	88	2.06%	39.2	0.98	2.09	4.92
06-29-12	1.53	413	219,369	335.63	41	95	1.87%	45.5	0.89	2.11	5.69
07-06-12	1.69	330	219,039	370.18	46	102	1.86%	34.5	1.31	1.42	6.27
07-13-12	2.02	309	218,730	441.83	57	109	2.01%	71.7	0.79	2.55	7.49

Chinook Freshwater Pens

RW-21												
SAMPLE DATE	GRAMS/ FISH	MORTS	NUMBER FISH	KG. FISH	FOOD FED (KG's)	NO. DAYS	% BODY WT. FED	WT. GAIN	CONVER- SION	%DSGR	DENS.	
07-20-12	2.75	139	218,591	601.13	78	116	N/A	N/A	N/A	N/A	10.19	
07-27-12	2.95	137	218,454	644.44	93	123	2.13%	43.3	2.13	1.00	10.92	
08-03-12	3.45	269	218,185	752.74	108	130	2.21%	108.3	0.99	2.24	12.76	
08-10-12	3.95	94	218,091	861.46	119	137	2.11%	108.7	1.09	1.93	24.61	
08-17-12	4.90	358	217,733	1066.89	130	144	1.93%	205.4	0.63	3.08	18.08	

RW-21												
SAMPLE DATE	GRAMS/ FISH	MORTS	NUMBER FISH	KG. FISH	FOOD FED (KG's)	NO. DAYS	% BODY WT. FED	WT. GAIN	CONVER- SION	%DSGR	DENS.	
08-24-12	6.10	48	108,711	663.14	N/A	151	N/A	N/A	N/A	N/A	11.24	
08-31-12	6.55	21	108,690	711.92	112	158	2.33%	48.8	2.29	1.02	12.07	
09-07-12	7.25	14	108,676	787.90	119	165	2.27%	76.0	1.56	1.45	13.35	
09-14-12	7.50	17	108,659	814.94	132	172	2.35%	27.0	4.86	0.48	13.81	
09-21-12	8.10	17	108,642	880.00	108	179	1.82%	65.1	1.66	1.10	14.92	
10-19-12	12.10	42	108,600	1314.06	356	207	1.16%	434.1	0.82	1.43	22.27	

RW-21												
SAMPLE DATE	GRAMS/ FISH	MORTS	NUMBER FISH	KG. FISH	FOOD FED (KG's)	NO. DAYS	% BODY WT. FED	WT. GAIN	CONVER- SION	%DSGR	DENS.	
10-19-12	12.10	42	108,600	1314.06	356	207	1.16%	434.1	0.82	1.43	22.27	
11-30-12	11.60	51	108,549	1259.17	191	249	0.35%	-54.9	0.00	-0.10	21.34	
01-04-13	11.50	54	108,495	1247.69	90	284	0.21%	-11.5	0.00	-0.02	21.15	
02-01-13	12.90	67	108,428	1398.72	81	312	0.22%	151.0	0.53	0.41	23.71	
03-08-13	11.25	102	108,326	1218.67	116	347	0.25%	-180.1	0.00	-0.39	20.66	
04-12-13	13.55	129	108,197	1466.07	178	382	0.38%	247.4	0.71	0.53	24.85	
04-30-13	15.85	60	108,137	1713.97	108	400	0.38%	247.9	0.43	0.87	29.05	
05-31-13	18.20	111	108,026	1966.07	222	431	0.39%	252.1	0.87	0.45	33.32	

Cannibalism

- Proper feeding technique can help minimize this
- More common in chinook than coho
- Problematic with chinook held long term in saltwater net pens.
- Grading can help with this
- Smaller fish lose out



Grading and enumeration



Sampling Growth

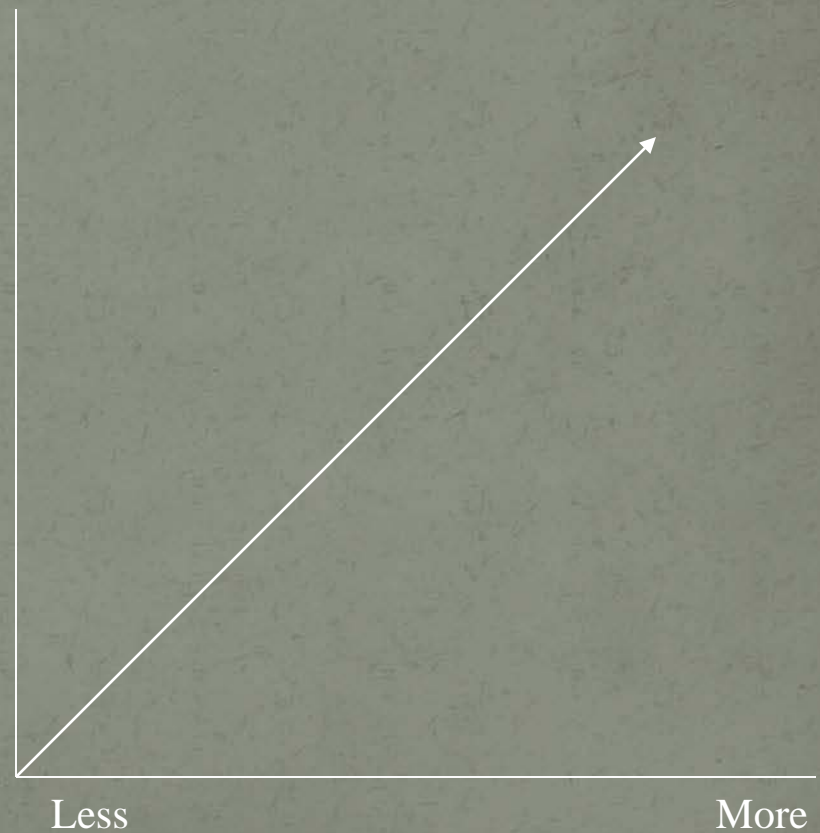
- Collecting good samples representative of the population in the pen can be difficult especially when individuals are not uniform in size.



Chinook

Coho

Sockeye



Size Variability

Methods

- Remember what methods one might use to sample a net pen?

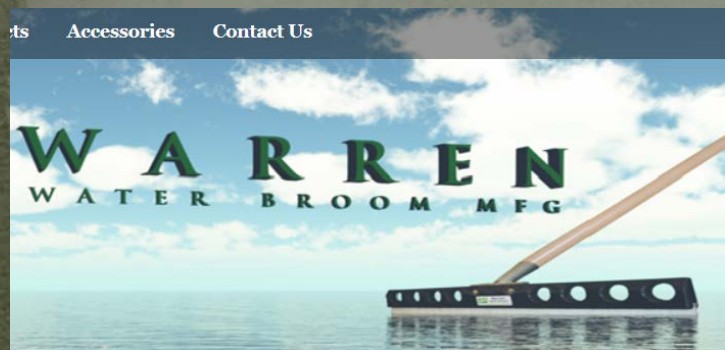
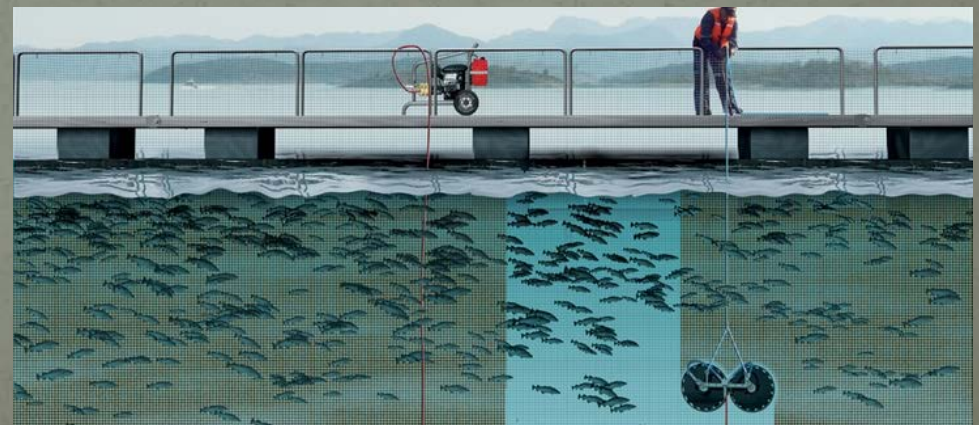


http://rebeccamoser.blogspot.com/2007_04_01_archive.html

Interesting personal account of being at a remote site

Maintenance

- Keeping mesh open is critical to providing flow to fish
- How do you do this?
 - Brushing
 - Wash and exchange
 - Hydraulic scrubbers
 - Drying



Mort collection

- Dipnet
- Diving (only if you have to!)
- Pneumatic system



Eductor pump principle
The compressed air is injected through a number of small holes in a separate air chamber. The benefits obtained by the stream of injected air entered through many holes, is to create a constant and rapid flow.



Release

- Prior to, it's a good idea to know:
 - Length, weight, general condition
 - Cwt evaluation if applicable
- Enumeration:
 - Not really possible with large numbers
 - Chinook/coho/sockeye could be enumerated
 - Need to weigh stress on fish vs. value of number
- Night release – cover of darkness
- Outgoing tide
- Predators around?



Fish Health in Netpens

- Signs of disease in netpens
 - Dead fish or listless fish
 - Pinheads or emaciated fish
 - Flashing
 - Crowding into corners or sides of net
 - Poor feed response



Fish Health in Netpens

- Not as much control as in land-based containers
- Hard to treat external pathogens
- Wild (small) fish may swim into pens/often carry disease organisms
- Some disease organisms start in fw but come to surface in sw
- Perfect Storm: pathogen + poor environment + stress



Fish Health in Netpens

- Be proactive:
 - Assure fish are in excellent health prior to sw entry
 - Some specialty feeds may help
 - Vaccination?
- Entry to SW will decrease fish appetite, generally
- Think about what fish are going through!



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BioSupreme



Description

BioSupreme, previously known as BioTransfer, is formulated to help prepare juvenile salmon for the transition from fresh to saltwater environments. Elevated levels of dietary salt encourage the development of osmoregulatory ability while added betaine acts as an osmoprotectant by relieving gastrointestinal stress. BioSupreme should be fed for 6 weeks prior to transfer to Saltwater.

Feed Size

- 1.2 mm Pellet (available seasonally)
- 1.5 mm Pellet (available seasonally)
- 2.0 mm Pellet

More Product Info

- [Product Sheet](#)
- [Feed Size Chart](#)

BioPro 2



Description

BioPro 2 is a new health promoting diet designed to be fed leading up to stressful situations, including periods of high disease risk or adverse environmental conditions such as elevated summer water temperatures, intense sunlight or low dissolved oxygen.

- BioPro 2 supports the immune system
- BioPro 2 fortifies the fish's store of antioxidants and vitamins improving anti-oxidative capacity
- BioPro 2 stabilizes gut micro-flora and supports gut health
- BioPro 2 improves feed intake, digestion and the availability of nutrients

More Product Info

- [Product Sheet](#)
- [Feed Size Chart](#)

Fish Health in Netpens

- Bacterial Kidney Disease
 - Can occur in cold water temps
 - Slow/chronic mortality
 - Treat with Erythromycin if necessary
 - Best to prevent through family tracking
- Vibriosis
 - Infection can come from presence of wild fish
 - Rapid/acute mortality
 - Treat with Terramycin
 - Vaccine is highly effective
- Coldwater Disease
 - Natural pathogen
 - Chronic/necrosis of tissue near peduncle
 - Treatable with Terramycin

