Growth Measurements & Feeding Rates

2015 Alaska fish culturist meeting/ Kodiak

Tuesday January 20,2015

Time	Presenter	Topic
8:00 - 9:00	Registration at the Kodiak Refuge Visitor Center upstairs	
9:00 - 9:05	Tina Fairbanks, KRAA Executive Director	Welcome to Kodiak!
9:05 - 9:25	Donn Tracey ,Tyler Pollum	Kodiak Sportfish Division
9:25 - 9:45	Andrew Walter	PCH Dry Marking
9:45 - 10:05	Nate Weber	KRAA Research
10:05 - 10:20	Break	
10:20 - 10:40	Genny West	Aquatic Eco / Pentair
10:40 - 10:55	Gary Byrne	IDFG Production Overview
10:55 - 11:15	Malia Gallagher	Clearwater Fish Hatchery IDFG
	Tony Folsom	Clearwater Fish Hatchery IDFG
11:15 - 11:35	Bob Becker	Nampa Hatchery, IDFG
11:35 - 11:55	Flip Pryor	ADFG Prince William Sound
12:00 - 1:20	Lunch	
1:20 - 1:40	Lorraine Vercessi	Juneau ADF&G
1:40 - 2:00	NSRAA staff	NSRAA presentation
2:00 - 2:20	Hawk Turman	PCH smolt camps
2:20 - 2:50	Lon Garrison	Sitka Science Center
2:50 - 3:05	Break	
3:05 - 3:25	KBH Staff	Kitoi Bay Hatchery
3:25 - 3:45	KBH Staff	Kitoi Bay Hatchery
3:45 - 4:05	Henry Titus	NVWM Chinook/coho project

2015 Alaska Fish Culture Conference

Thursday January 22

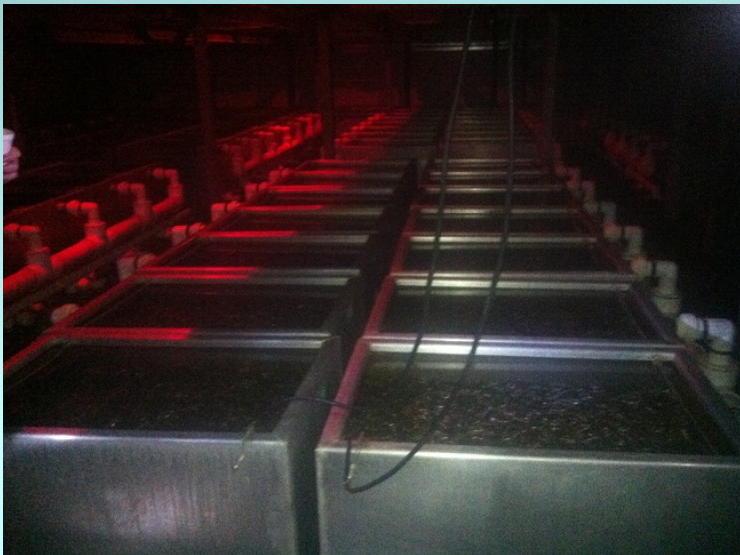| Time	Presenter	Organization
9:00 - 9:20	Akva Group	Aquaculture Supply
9:20 - 9:40	Jayde Ferguson	ADF&G Pathology
9:40 - 9:55	John Hunter	Frontier Supply
9:55 - 10:15	Kurt Stelk	Jensorter
10:15 - 10:30	Break	
10:30 -10:50	Ron Malnor	Skretting Feeds
10:50 - 11:10	Scott Wagner	NSRAA operations
11:10 - 11:30	Klint Hischke	WNH Operations
11:30 - 1:15	Lunch	
1:15 - 1:35	Jay Myhrer	MBH Operations
1:35 - 1:55	Tetratech Staff	Tetratech Services
1:30 - 1:50	Christensen Networks Staff	Christensen Services
1:50 - 2:10	Rich Morris	Fish Pathology, ADFG
2:10 - 2:30	Dipac Staff / Charles Currit	DIPAC Operations/Hatcheries
2:30 - 2:50	Break	
2:50 - 3:10	Ben Gilles	Quinault Fish Hatchery
3:10 - 3:30	Bill Gass	SSRAA Operations
3:30 - 3:50	Jim Sealand	UAA Fisheries Program

Vertebral Growth Plate

Whale Barnacle
Cryptolepas rachianecti

Gray Whale Baleen

Pillar Creek

Kitoi Bay Hatchery

http://youtu.be/a1rjFm36Eno

Addendum to "predators" from the previous lesson........

Place this in the "when you think you've seen it all" category!

"hey boss, we gotta humpback in the net pens!"

http://www.youtube.com/watch?v=GZWHugjZONw

Historical Trends

1. Why forecasting growth is important
2. HOW to forecast growth
3. Why looking back at growth history is important
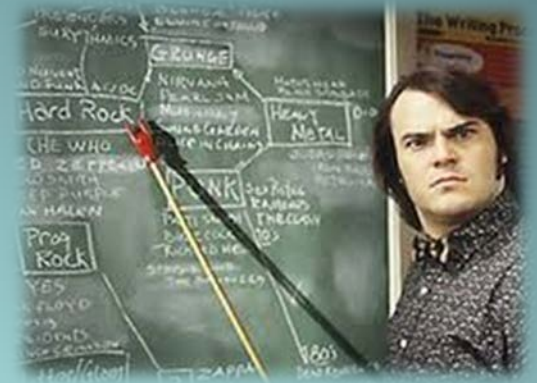4. HOW to look back at growth history

Why do we need to be able to measure and predict rate of growth?

Why is this information important?

- A measure of efficiency
- Compare with other broodyears
- Planning
  - Feed orders
  - Rearing space
- Budgeting
- Meeting production goals

Determining Rate of Growth – Looking into the past

- It is important to be able to measure and predict growth rates in order to <u>meet production goals</u>.
- Growth rates are used to forecast:
  - stock rotation
  - rearing densities
  - time of release at a desired size
  - feeding levels
- The **Daily Specific Growth Rate (DSGR)** measures the daily increase in weight of the fish as a <u>percent of body weight gained per day</u>
- Growth rates vary depending on: fish health, water temperature and quality, feed type and fish species

Measuring Growth Rates

- DSGR measures <u>rate</u> of growth
- Knowing rate of growth allows you to meet goals
- Production goals will vary with the project
- Controlling growth is critical to proper hatchery management.
  - Early stage growth can be controlled during incubation by manipulating water temperature
  - Later stages of growth can be controlled by a variety of factors including temperature (if available), feed type, feed amounts, and other strategies

Measuring Growth Rates

- Example – If you have a net pen of chum salmon that are growing at 4.5% daily their body weight will increase each day by 4.5%

  - Day 1 the avg. wt. = 1.5 gms

  - Wt. on **day 2** = 1.5 x .045 = .0675 + 1.5 = **1.567gms**

  - On **day 7** they'll be **2.04g**

  - For a pen of 2.5 million fish this means the biomass will increase by **1200kg or 2600# (> 1 ton!)**

- Better have food ready and extra living space!

Calculating DSGR from Sample Data

- In order to calculate the DSGR we need to know:
  - The number of days in the sample period
  - The weight of the fish on day 1
  - The weight of the fish on day 2 (most recent sample)
  - Plus we need a calculator that can do <u>natural logs</u>

The formula is:

$$DSGR = \frac{\ln W_2 - \ln W_1}{\# \text{ days in period}} \times 100$$

Natural log
function key

→

Calculator

View Edit Help

0

○ Degrees ○ Radians ○ Grads | MC | MR | MS | M+ | M-

Inv | ln | (|) | ← | CE | C | ± | √

Int | sinh | sin | x^2 | n! | 7 | 8 | 9 | / | %

dms | cosh | cos | x^y | $\sqrt[y]{x}$ | 4 | 5 | 6 | * | 1/x

π | tanh | tan | x^3 | $\sqrt[3]{x}$ | 1 | 2 | 3 | - | =

F-E | Exp | Mod | log | 10^x | 0 | . | +
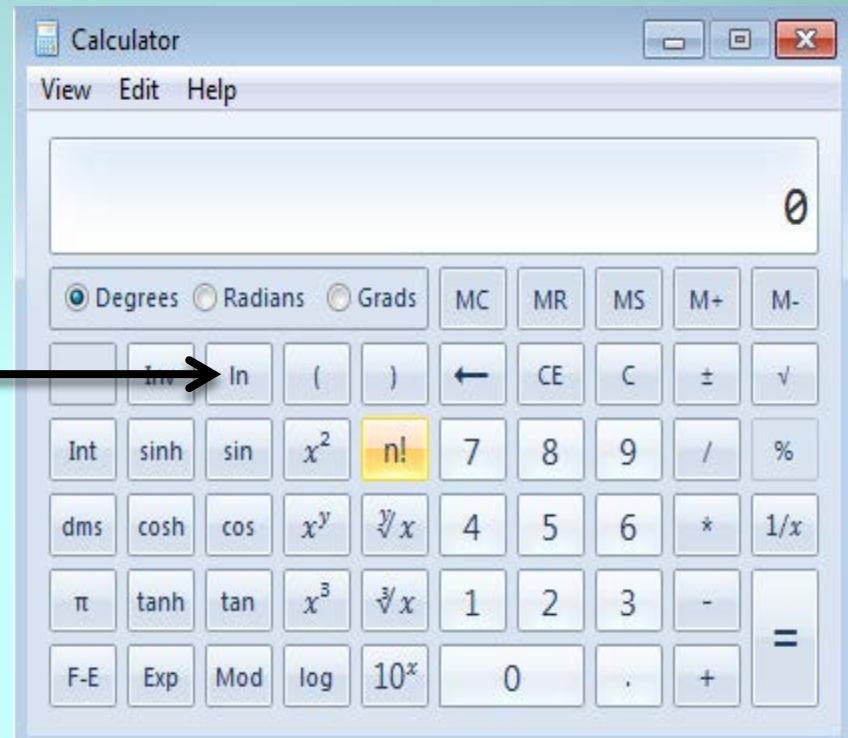
Calculating DSGR from Sample Data

- Wt_1 of fish on day 1= 12 grams (ln = 2.485)
- Wt_2 of fish on day 14= 15 grams (ln = 2.708)
- Number of days in Sample =14

$$\frac{(Wt_2 = 2.708) - (Wt_1 = 2.485)}{14 \text{ days}} \times 100 = 1.59$$

DSGR = 1.59%

Enter 15, hit "ln" (current weight)

"-" Enter 12, hit "ln" (previous wt.)

"=" divide by 14 (no. of days)

* 100 then "=" (to get percent)

# Projecting growth – looking into the future

- Knowing the DSGR will allow you to <u>predict</u> what size a fish will be at a future date assuming growth remains constant

You can do this by longhand...........

Day	Wt	DSGR	Daily Gain	Day	Wt	DSGR	Daily Gain
0	15	0.022	0.33	14	20.34247544	0.022	0.44753446
1	15.33	0.022	0.33726	15	20.7900099	0.022	0.457380218
2	15.66726	0.022	0.34467972	16	21.24739011	0.022	0.467442582
3	16.01194	0.022	0.352262674	17	21.7148327	0.022	0.477726319
4	16.3642	0.022	0.360012453	18	22.19255901	0.022	0.488236298
5	16.72421	0.022	0.367932727	19	22.68079531	0.022	0.498977497
6	17.09215	0.022	0.376027247	20	23.17977281	0.022	0.509955002
7	17.46817	0.022	0.384299846	21	23.68972781	0.022	0.521174012
8	17.85247	0.022	0.392754443	22	24.21090182	0.022	0.53263984
9	18.24523	0.022	0.40139504	23	24.74354166	0.022	0.544357917
10	18.64662	0.022	0.410225731	24	25.28789958	0.022	0.556333791
11	19.05685	0.022	0.419250697	25	25.84423337	0.022	0.568573134
12	19.4761	0.022	0.428474213	26	26.41280651	0.022	0.581081743
13	19.90457	0.022	0.437900645	27	26.99388825	0.022	0.593865541
				28	27.58775379	0.022	0.606930583
				29	28.19468437	0.022	0.620283056
				30	28.81496743		

This operation does the multiplication expansion for you
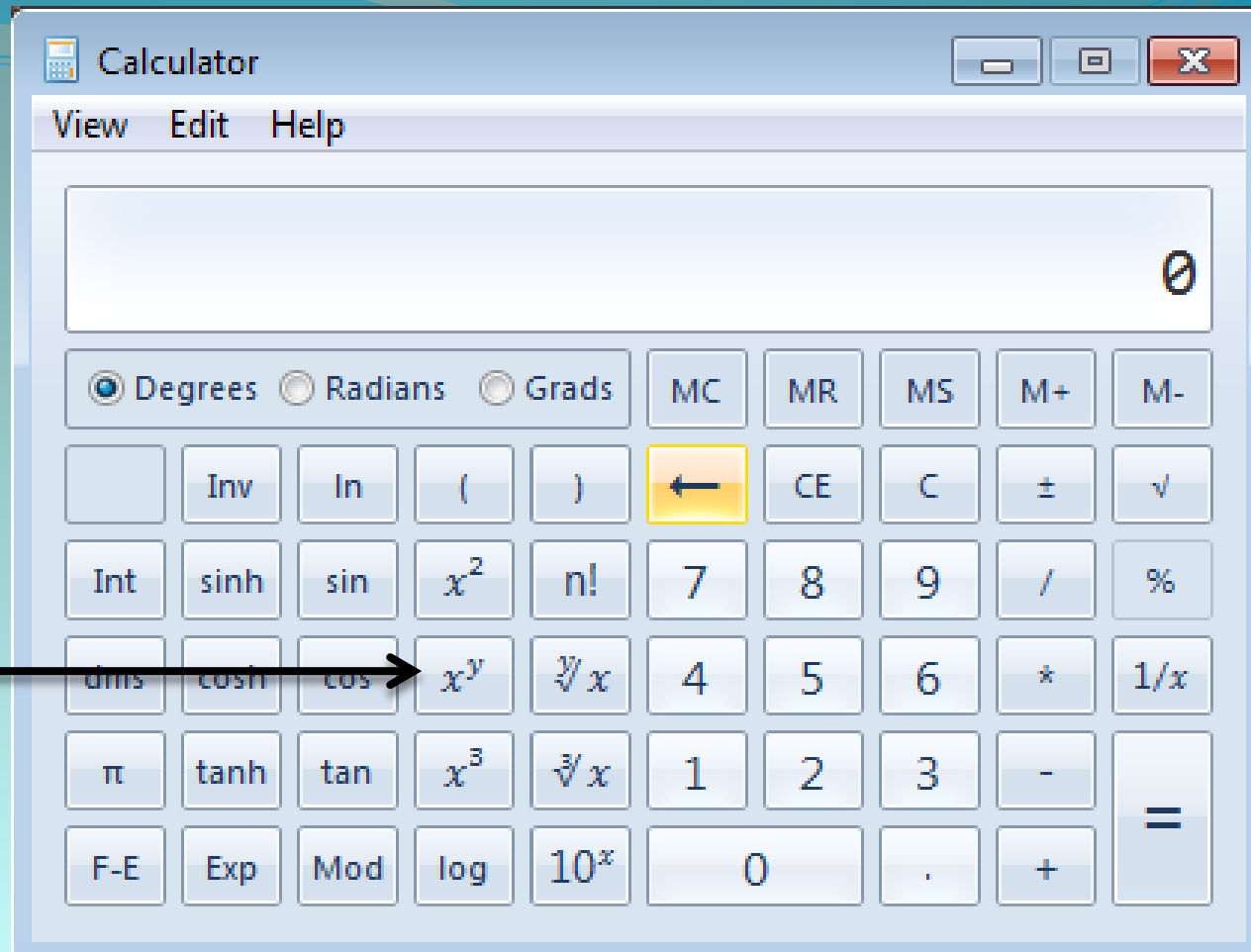
Example:
For a 2gram fish, growing at 2%/day * 14 days:
Enter 2.0 * 1.02 and hit the key above, enter 14 then "=" and you get the projected weight of 2.64g.   Try it!

Food Conversion – A Measure of Efficiency

- A measure of how efficiently the fish are converting food into flesh

- Expressed as "FCR" = Feed Conversion Rate

- A FCR of 1:1 means that for <u>every kilogram of feed</u> fed the fish <u>put on a kilogram of weight</u>.

- FCR's can be high (not good) 2:1, 3:1

- or low (good, to a certain extent) 1:1, 0.8:1, 0.5:1

- With today's feeds, low FCR are commonplace. 1:1 is a good target

- FCR = Food Fed/Wt. gain

- **What factors would affect FCR's?**

Condition Factor (K)

- Condition Factor is the relationship of fish length to weight

- Are they lean or heavy? **Why would we care?**

- A condition factor of .9 – 1 is assumed to be ideal for salmon smolts preparing to migrate to the ocean.

- K factors for fish in an aggressive production schedule will often exceed 1.0

- The formula is: $K = Weight(g)/Length(mm)^3 * 100,000$

FHM 60-61 FRED 54-55

K Factor

- K factors <u>will vary by specie and stage of development.</u>
- Based on SSRAA sample data:
  - NB Coho BY'oo wt = 31gms   <u>K = 1.02</u>
  - CL Chinook BY'oo wt = 13.8gms <u>K = 1.12</u>
  - NB SC BY'o1 wt = 2.8gms   <u>K = .89</u>

One person's idea of "exceptional" is another person's idea of "obese"!

EXTREMELY POOR

Species:	Brown trout	**Length:**	505 mm
Sex:	Female	**Weight:**	1 000 g
Gonad stage:	Ripe	**K Factor:**	0.78
Comment:	Fish is long and thin with very little flesh.		

POOR

Species:	Brown trout	**Length:**	435 mm
Sex:	Female	**Weight:**	700 g
Gonad stage:	Ripe	**K Factor:**	0.95
Comment:	This fish is also long and thin.		

FAIR

Species:	Brown trout	**Length:**	400 mm
Sex:	Female	**Weight:**	760 g
Gonad stage:	Mature	**K Factor:**	1.19

GOOD

Species:	Brown trout	**Length:**	400 mm
Sex:	Female	**Weight:**	870 g
Gonad stage:	Mature	**K Factor:**	1.36

EXCELLENT

Species:	Brown trout	**Length:**	545 mm
Sex:	Female	**Weight:**	2 680 g
Gonad stage:	Ripe	**K Factor:**	1.66

EXCEPTIONAL

Species:	Brown trout	**Length:**	510 mm
Sex:	Female	**Weight:**	2 680 g
Gonad stage:	Ripe	**K Factor:**	2.02

How to measure fork length
In AK we use metric, so "mm"

FORK LENGTH

Mid-eye to fork

Fork Length

Total Length
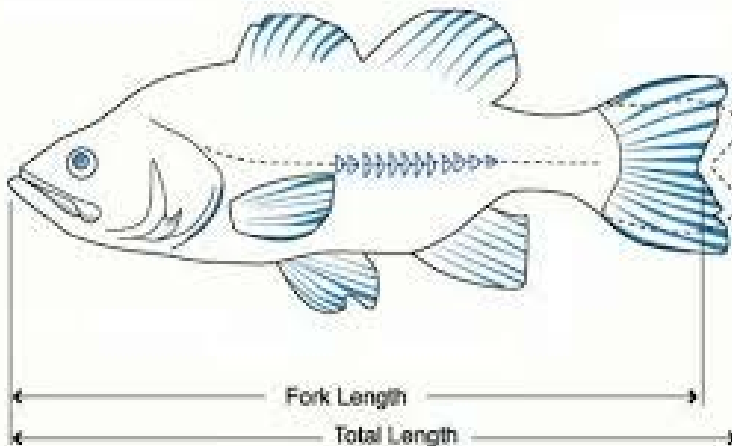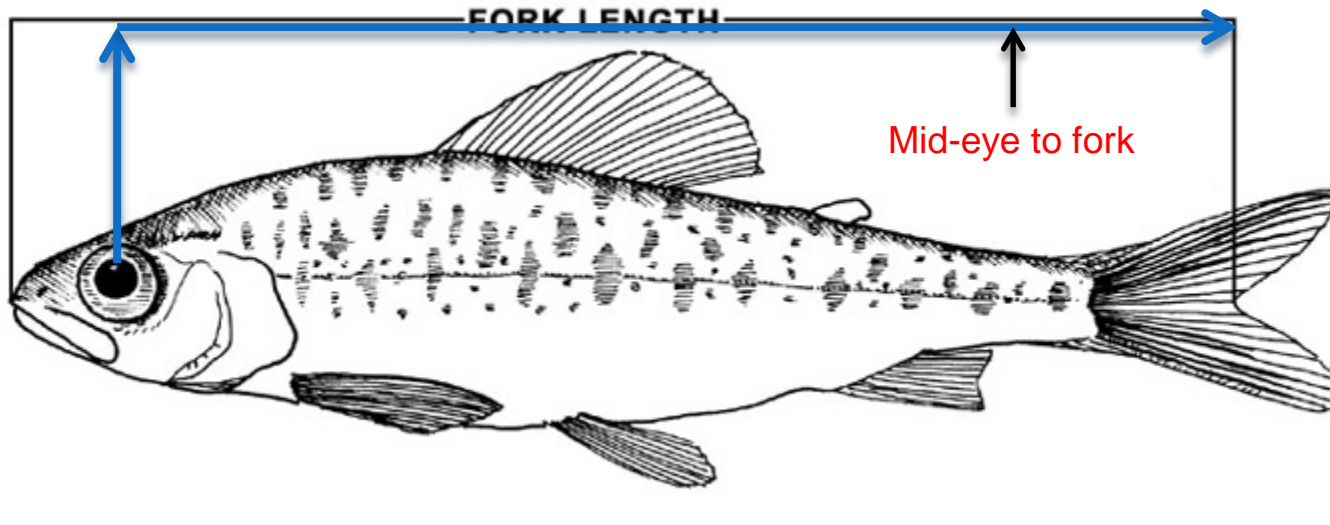
In some cases you might want to take mid-eye to fork

Typical hatchery recordkeeping chart

Some charts might also calculate for K factor

	B	C	D	E	F	G	H	I	J	K	L
2	Container:	M1									
3											
4	Site:	MCIF									
5	Broodyear:	2003									
6	Species:	Chum									
7	Stock:	MED									
8	Ponding Pop.:	2,583,000									
9	Ponding Date:	26-Feb-04									
10	Feed Type:	BV #0-#1			released pm 4/17/03 @ 3.03g						
11	Release Date:	26-Apr-04			released pm 4/26/04 @ 2.03g						
12											
13	Data Entry		Current	Total			#	Wt.	%		% Body
14	Date	Temp	Wt. (gm)	Feed (kg)	Morts	Population	Days	Gain	GPD	CR	Wt. Fed
15	26-Feb-04	5.8	0.41	0	0	2,583,000	0	0	0		
16	13-Mar-04	5.5	0.62	360	0	2,583,000	16	542	2.58%	0.66	1.69%
17	22-Mar-04	6.6	0.74	357	0	2,583,000	9	310	1.97%	1.15	2.26%
18	30-Mar-04	6.6	0.87	475	0	2,583,000	7	336	2.31%	1.41	3.26%
19	03-Apr-04	5.6	0.97	275	0	2,583,000	4	258	2.72%	1.06	2.89%
20	11-Apr-04	6.4	1.40	580	0	2,583,000	8	1111	4.59%	0.52	2.37%
21	18-Apr-04	6.7	1.72	625	200	2,582,800	8	826	2.57%	0.76	1.94%
22	26-Apr-04	7.0	2.03	705	700	2,582,100	8	799	2.07%	0.88	1.82%
23											
24											
25											
26	TOTALS	6.3	2.03	3,377	900	2,582,100	60	4183	2.67%	0.81	1.99%
27											
28											

C / 00 BY chum / 01 BY chum / 02 BY chum \ 03 BY chum / 04 BYcnum 03 coho / 01 BY coho /

Ready   NUM

Production Planning

- Use of DSGR, FCR and weight projections for budgeting
- Also used for:
  - Feed orders
  - Project planning
  - Anticipating rearing container needs

Basic tour of a spreadsheet...

Formulas are typed into a spreadsheet program normally

#days are calculated here

To calculate weight or biomass gain...

Excel spreadsheet — medvejie chum growth

Formula bar cell I16: `=((G16*D16)-(G15*D15))/1000`

	Container:	M1									
	Site:	MCIF									
	Broodyear:	2003									
	Species:	Chum									
	Stock:	MED									
	Ponding Pop.:	2,583,000									
	Ponding Date:	26-Feb-04									
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Sheet tabs: 99 BY chum / work 99 chm / C / 00 BY chum / 01 BY chum / 02 BY chum / 03 BY chum / 04 BYcnum 03 coho / 01

To calculate %gain per day...

Microsoft Excel - medvejie chum growth

J16 = =(LN(D16)-LN(D15))/H16

	A	B	C	D	E	F	G	H	I	J	K	L	M
2		Container:	M1										
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99 BY chum / work 99 chm / C / 00 BY chum / 01 BY chum / 02 BY chum / 03 BY chum / 04 BYcnum 03 coho / 01

Ready

To calculate conversion rate...

Microsoft Excel - medvejie chum growth

File Edit View Insert Format Tools Data Window Help

K16   =   =E16/I16

	B	C	D	E	F	G	H	I	J	K	L	M
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4	Site:	MCIF										
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99 BY chum / work 99 chm / C / 00 BY chum / 01 BY chum / 02 BY chum / **03 BY chum** / 04 BYcnum 03 coho / 01

Ready   NUM

To calculate average % body weight fed…

Microsoft Excel - medvejie chum growth

File Edit View Insert Format Tools Data Window Help

L16 = =(E16/H16)/((AVERAGEA(D15:D16))*(G16/1000))

	A	B	C	D	E	F	G	H	I	J	K	L	M
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99 BY chum / work 99 chm / C / 00 BY chum / 01 BY chum / 02 BY chum / 03 BY chum / 04 BYcnum 03 coho / 01

Ready

Using performance data for budgeting purposes

Microsoft Excel - feed performance calculator

C24

	B	C	D	E	F	G	H	I	J	K	L
1											
2	BioVita										
3			size	size		feed	Total kg		Total kg.	Total	Cumulative
4	BY/species	population	start	end	CR	type/size	biomass	price/kg	required	Price	Price
5		1,000,000	0.35	0.75	0.93	0/1	400	$1.89	372	$703.08	$703.08
6		1,000,000	0.75	1.00	0.87	0.8	250	$1.82	217.5	$395.85	$1,098.93
7		1,000,000	1.00	2.00	0.8	1	1000	$1.75	800	$1,400.00	$2,498.93
8					0.81		1250		1017.5	$2,498.93	
9											
10											
11	Apollo										
12			size	size		feed	Total kg		Total kg.	Total	Cumulative
13	BY/species	population	start	end	CR	type/size	biomass	price/kg	required	Price	Price
14		1,000,000	0.35	0.5	1.1	0	150	$1.68	165	$277.20	$277.20
15		1,000,000	0.50	0.75	0.95	0	250	$1.68	237.5	$399.00	$399.00
16		1,000,000	0.75	1.20	0.95	1	450	$1.68	427.5	$718.20	$1,117.20
17		1,000,000	1.20	2.00	0.9	1	800	$1.68	720	$1,209.60	$2,326.80
18					0.92		1500		1385	$2,326.80	
19											
20		Price difference =		$172.13	per million fish						
21											

- Have to assume: wts, FCR for this one
- Have to hassle the feed guys for pricing!

Growth projections for budgeting and project planning

7025/200 Fish Food

BY/species	period covered	population start	population end	size start	size end	CR	feed type/size	price/kg	Total kg. required	Total Price
02 chinook	7/03-9/03	1,100,000	1,100,000	8.0	13.0	1.2	CF 1.5mm	$1.04	6,600	$6,864
for Medv.	9/03-10/15	1,100,000	1,100,000	13.0	17.0	1.2	Nutra Xfr FW	$1.40	5,280	$7,392
	10/15-11/15	1,100,000	1,100,000	17.0	21.0	1.2	Smolt HP	$1.36	5,280	$7,181
	medication	1,078,000	1,078,000	26.0	26.0	1.2	M/C 6% TM	$2.20	1,800	$3,960
	11/15-5/20	1,050,000	1,050,000	21.0	50.0	1.2	CF 2.5/3.5	$0.84	36,540	$30,694
	Totals								55,500	$56,090
03 chinook	1/04 -	250,000	250,000	0.42	0.90	1.2	BDS #3	$1.94	144	$279
for Medv		250,000	250,000	0.90	2.00	1.2	BDG 1.0	$1.77	330	$584
0+ release		250,000	250,000	2.00	3.50	1.2	BDG 1.0/Aq100	$3.57	450	$1,607
		250,000	250,000	3.50	6.00	1	CF 1.5mm	$1.04	625	$650
		250,000	250,000	6.00	8.00	1	Nutra Xfr FW	$1.40	500	$700
	- 7/03	250,000	250,000	8.00	15.00	1	Smolt HP	$1.36	1,750	$2,380
									3,799	$6,200
02 Chinook	7/1-10/03	1,000,000	1,000,000	1.5	2.0	1.1	BDG 1.0mm	$1.77	550	$974
for GL	7/11-9/1	1,000,000	1,000,000	2.0	7.5	1	CF 1.5/2.0	$1.02	5,500	$5,610
	9/1-10/15	1,000,000	1,000,000	7.5	22.0	1	Nutra Xfr FW	$1.40	14,500	$20,300
	10/15-11/15	980,000	980,000	22.0	26.0	1.2	Smolt HP	$1.36	4,704	$6,397
	medication	980,000	980,000	26.0	26.0	1.2	M/C 6% TM	$2.29	1,800	$4,122
	12/03-5/04	970,000	970,000	26.0	60.0	1.2	CF 2.5/3.5	$0.84	39,576	$33,244
	Totals								66,630	$70,647
03 Chinook	1/03-	1,150,000	1,130,000	0.42	0.90	1.2	BDS #3	$1.94	641	$1,243
for Medv.		1,130,000	1,100,000	0.90	2.00	1.2	BDG 1.0	$1.77	1,420	$2,513
		1,100,000	1,100,000	2.00	3.50	1.2	BDG 1.0/Aq100	$3.57	1,980	$7,069
	-6/03	1,100,000	1,100,000	3.50	8.00	1.2	CF 1.5mm	$1.04	5,940	$6,178
	Totals								9,980	$17,002
03 Chinook	3/03 -	1,050,000	1,050,000	0.42	0.90	1.2	BDS #3	$1.94	605	$1,173
for GL	-6/03	1,000,000	1,000,000	0.90	1.50	1.2	BDG 1.0/Aq100	$3.57	720	$2,570
	Totals								1,325	$3,744
03 Chum	2/03-	50,000,000	50,000,000	0.34	0.50	1.8	Nutra 0	$1.93	14,400	$27,792
		50,000,000	50,000,000	0.50	1.00	1.1	Nutra 1	$1.91	27,500	$52,525
		50,000,000	50,000,000	1.00	1.20	1	Nutra 1	$1.91	10,000	$19,100
		50,000,000	50,000,000	1.20	1.80	0.95	Nutra 1	$1.91	28,500	$54,435
		22,000,000	22,000,000	1.80	2.00	0.95	Nutra 2	$1.82	4,180	$7,608
		7,000,000	7,000,000	2.00	2.50	0.95	Nutra 2	$1.82	3,325	$6,052

Multiple year classes and species – take *one at a time* and then add all together. Note various feed types and sizes; Have to assume growth rates and FCR's for this one!

DEEP INLET

Weekly Data Summary

Broodyear 2004

Week Ending- __05/12/05__

A good summary of a chum rearing season.

Pen	Stock	Weight (g)	Population	Feed	Feed (kg)	# Days	Current Week %GPD	Total Avg. %GPD	Current Week CR	Total Avg. CR
D1	MCIF	2.24	2,511,000	Apollo	3945	58	2.80%	3.06%	0.91	0.84
D2	MCIF-LL	4.01	2,392,000	Apollo	7349	78	3.30%	3.02%	0.82	0.85
D3	MCIF	2.04	2,589,000	Apollo	4155	58	2.28%	2.90%	1.21	0.97
D4	MCIF	1.99	2,593,000	Apollo	3695	57	2.88%	2.90%	0.88	0.89
D5	MCIF-LL	3.95	2,618,000	Apollo	8084	77	3.40%	3.04%	0.79	0.86
D6	MCIF	2.16	2,600,000	Apollo	3975	56	2.85%	3.10%	0.90	0.86
D7	MCIF-HF	2.01	2,209,000	Apollo	3345	55	1.94%	2.94%	1.55	0.94
D8	MCIF	2.09	1,978,000	Apollo	2985	54	2.65%	3.06%	1.12	0.89
D9	MCIF	2.04	2,080,000	Apollo	3060	54	3.83%	3.02%	0.78	0.90
D10	HF	2.17	2,478,000	Apollo	4260	61	4.17%	2.90%	0.81	0.96
D11	HF	1.99	2,454,000	Apollo	3930	58	2.92%	2.90%	1.20	0.99
D12	HF	2.10	2,468,000	Apollo	4140	62	2.93%	2.80%	1.00	0.97
D13	HF	1.92	2,467,000	Apollo	3250	54	2.76%	3.15%	0.93	0.84
D14	HF-LL	3.92	2,904,000	Apollo	9327	72	3.70%	3.28%	0.86	0.90
D15	HF	2.00	2,475,000	Apollo	3685	58	3.34%	2.91%	0.61	0.91
D16	HF	1.99	2,470,000	Apollo	3580	56	3.34%	3.00%	0.75	0.89
D17	HF	2.05	2,465,000	Apollo	4010	59	3.22%	2.90%	1.05	0.97
D18	HF-LL	3.96	2,920,000	Apollo	9202	71	3.11%	3.34%	0.63	0.88
Total/Avg.		**2.48**	**44,671,000**		**85,977**		**3.08%**	**3.01%**	**0.93**	**0.92**

DSGR exercises

1. Chum fry DSGR
   - January 8 wt = 1.52g
   - January 21 wt = 1.92
2. Coho fingerlings
   - December 21 wt = 10.5g
   - January 21 wt = 12.2g
3. Pink fry
   - February 15 wt = .18g
   - February 28 wt = .25g

Answers for DSGR
(your answers may differ slightly depending on #days calculated)

1. 1.80%

2. 0.5%

3. 2.53%

Projecting wts exercise

1. Chum fry
    1. Weigh 1.4g today
    2. Assume DSGR of 2.6%
    3. Wt in 2 weeks?
2. Coho fingerlings
    1. Weigh 10.3g today
    2. Assume DSGR of 0.8%
    3. Wt in 30 days?
3. Pink fry
    1. Weigh .23g today
    2. Assume DSGR of 2.4%
    3. Wt in 1 week?

Answers for wt projection

1. 2.01g
2. 13.1g
3. .27g

Assignment due 2/2/15

- Read the SSRAA newsletter article entitled "Survival of a Few" and provide a short summary. The newsletter can be found either under Resources.

- Provide a short summary of article

- Watch "DSGR" video embedded in the Resources file (down at the bottom)