Growth Measurements & Feeding Rates

2015 Alaska fish culturist meeting/ Kodiak

Tuesday January 20,2015

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

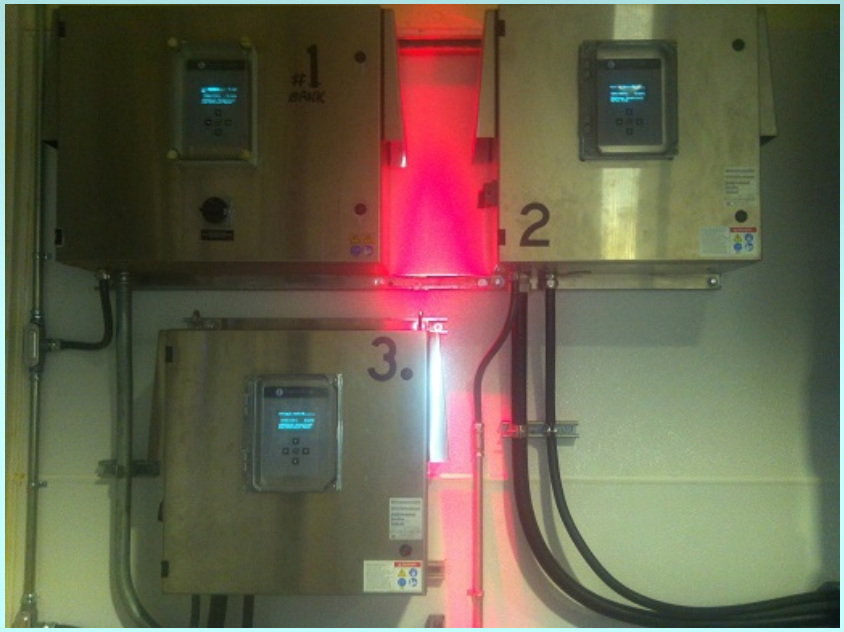
9:00 - 9:20	Akva Group	Aquaculture Supply
9:20 - 9:40	Jayde Ferguson	ADF&G Pathology
9:40 - 9:55	John Hunter	Frontier Supply
9:55 - 10:15	Kurt Stelk	Jensorter
10:15 - 10:30	Break	
10:30 -10:50	Ron Malnor	Skretting Feeds
10:50 - 11:10	Scott Wagner	NSRAA operations
11:10 - 11:30	Klint Hischke	WNH Operations
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


Whale Barnacle
Cryptolepas rachianecti
Vertebral Growth Plat
Gray Whale Baleen

Pillar Creek

Kitoi Bay Hatchery

http://youtu.be/a1rjFm36Eno


#1
2
3.

TEKLEEN Water Filters and Accessories > Screens

Screens

TEKLEEN® offers a w
filtration needs.

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

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 meet production goals.
- 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 percent of body weight gained per day
- Growth rates vary depending on: fish health, water temperature and quality, feed type and fish species

Measuring Growth Rates

- DSGR measures rate 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!

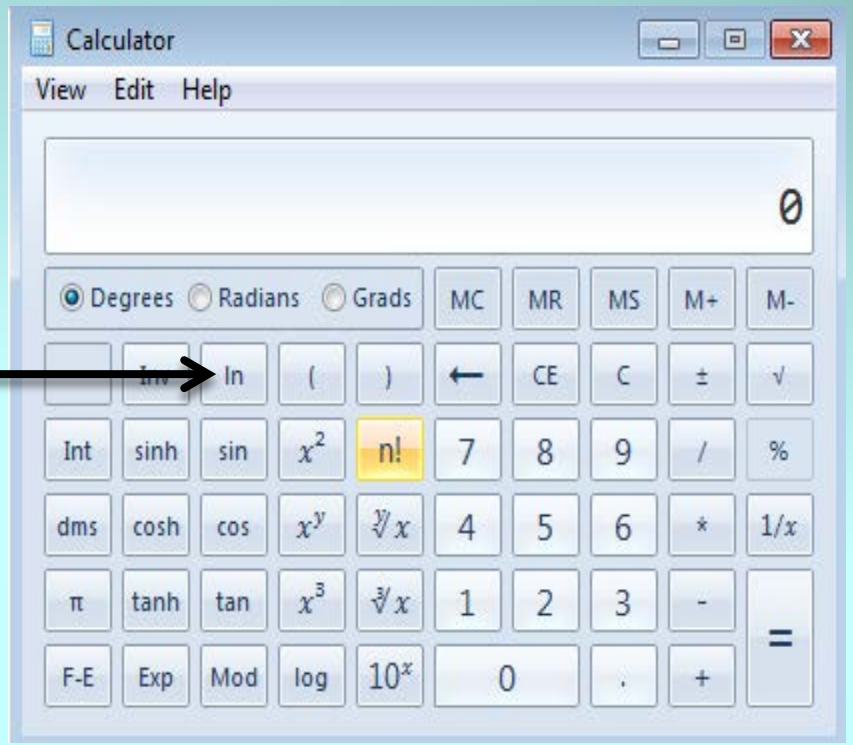
Calculating DSGR from Sample Data

- 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 natural logs

The formula is:

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

Natural log function key



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

$$\frac{(Wt2 = 2.708) - (Wt1 = 2.485)}{14 \text{ days}} \times 100 = 1.59$$

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)

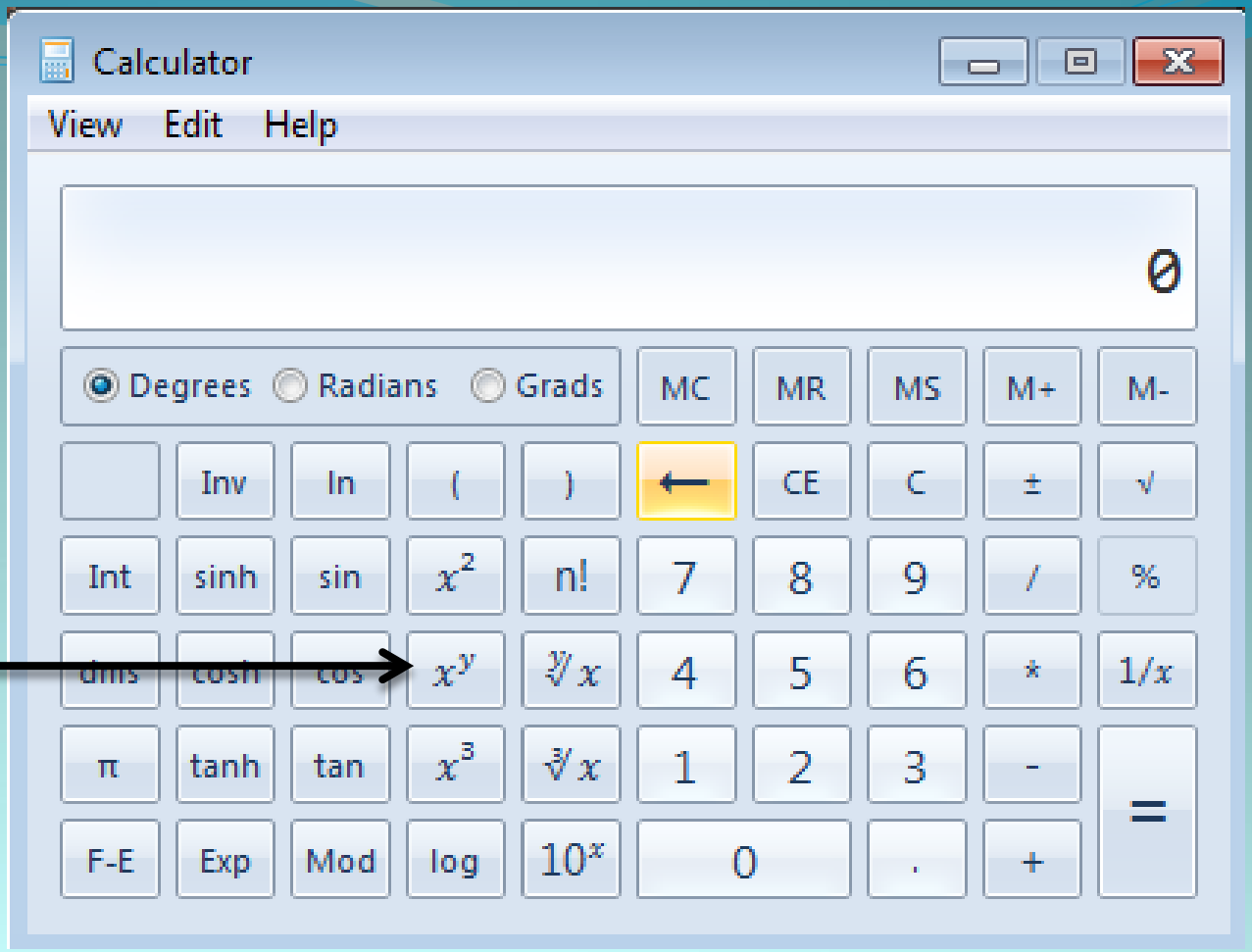
Projecting growth – looking into the future

- Knowing the DSGR will allow you to predict 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 every kilogram of feed fed the fish put on a kilogram of weight.
- 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?**


KEEP
CALM
AND
LETS
REVIEW

What is:

- DSGR
- What's it good for?
- Do you remember the formula?
- FCR
- What's it good for?
- Do you remember the formula?

DSGR can range from 0.1% to 5.0% or so
FCR can range from 0.5 to 2.0 or so

What factors might affect DSGR and FCR?

What if you calculation seems “way off” and hard to believe? Why might this happen / what would you do about it?

Looking at growth trends:

1. Jan 2 coho = 8g

   Feb 1 = 14g

   What is DSGR?

2. Feb 15 chum = .41g

   Feb 22 = .75

   What is DSGR?

3. March 12 chinook = .52g

   March 31 = .73g

   What is DSGR?

Projecting weight

1. Coho weigh .23g on Feb 3
    1. What will their weight be on Feb 28 if DSGR = 2%?
    2. How much biomass did they gain if population = 200k?
2. Chum weigh .53g on March 1
    1. What will their weight be on March 8 if DSGR = 1.8%?
    2. How much biomass is gained if population = 2 million?
3. Chinook weigh 18g on April 15
    1. What will their weight be by May 15 if DSGR = 2.5%?
    2. How much biomass is gained if population = 180,000?

Food Conversion Rate:

1. 200k coho @ 12g on April 1
    1. April 15 = 15.8g
    2. You fed 800kg of fish food
    3. What is FCR?

2. 2.3 million chum @ .48g on Feb 17
    1. Feb 24 = .58g
    2. You fed 220kg of fish food
    3. What is FCR?

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: $K = \text{Weight(g)}/\text{Length(mm)}^3 * 100{,}000$

FHM 60-61 FRED 54-55

K Factor

- K factors will vary by specie and stage of development.
- Based on SSRAA sample data:
  - NB Coho BY'00 wt = 31gms K = 1.02
  - CL Chinook BY'00 wt = 13.8gms K = 1.12
  - NB SC BY'01 wt = 2.8gms K = .89

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.		

FAIR

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

EXCELLENT

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

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.		

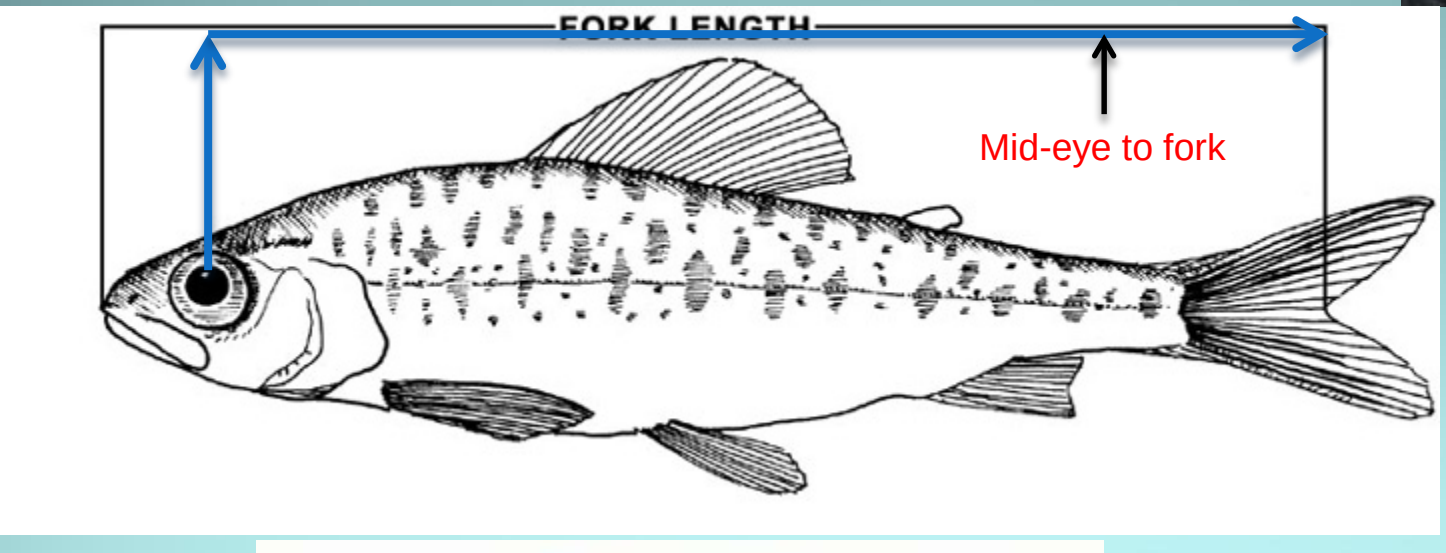
GOOD

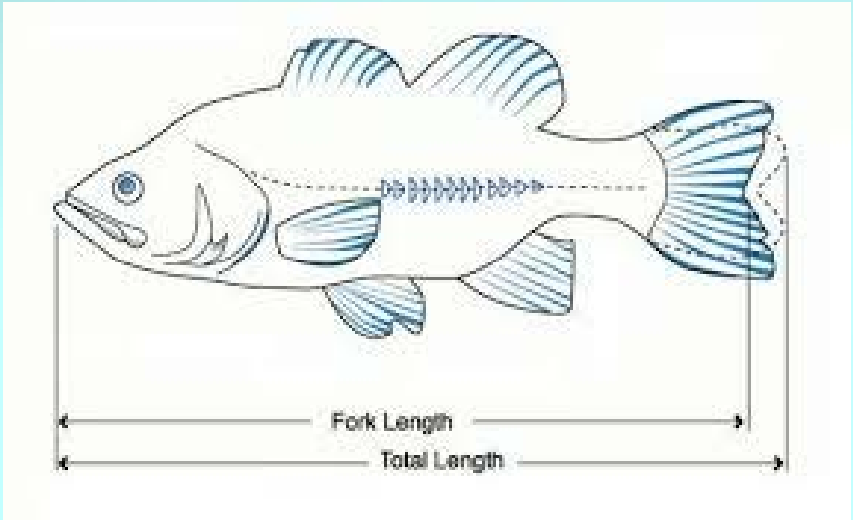
Species:	Brown trout	**Length:**	400 mm
Sex:	Female	**Weight:**	870 g
Gonad stage:	Mature	**K Factor:**	**1.36**

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”





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

Typical hatchery recordkeeping chart

Container:	M1
Site:	MCIF
Broodyear:	2003
Species:	Chum
Stock:	MED
Ponding Pop.:	2,583,000
Ponding Date:	26-Feb-04
Feed Type:	BV #0-#1
Release Date:	26-Apr-04

released pm 4/17/03 @ 3.03g
released pm 4/26/04 @ 2.03g

Some charts might also calculate for K factor

Data Entry Date	Temp	Current Wt. (gm)	Total Feed (kg)	Morts	Population	# Days	Wt. Gain	% GPD	CR	% Body Wt. Fed
26-Feb-04	5.8	0.41	0	0	2,583,000	0	0	0		
13-Mar-04	5.5	0.62	360	0	2,583,000	16	542	2.58%	0.66	1.69%
22-Mar-04	6.6	0.74	357	0	2,583,000	9	310	1.97%	1.15	2.26%
30-Mar-04	6.6	0.87	475	0	2,583,000	7	336	2.31%	1.41	3.26%
03-Apr-04	5.6	0.97	275	0	2,583,000	4	258	2.72%	1.06	2.89%
11-Apr-04	6.4	1.40	580	0	2,583,000	8	1111	4.59%	0.52	2.37%
18-Apr-04	6.7	1.72	625	200	2,582,800	8	826	2.57%	0.76	1.94%
26-Apr-04	7.0	2.03	705	700	2,582,100	8	799	2.07%	0.88	1.82%
TOTALS	6.3	2.03	3,377	900	2,582,100	60	4183	2.67%	0.81	1.99%

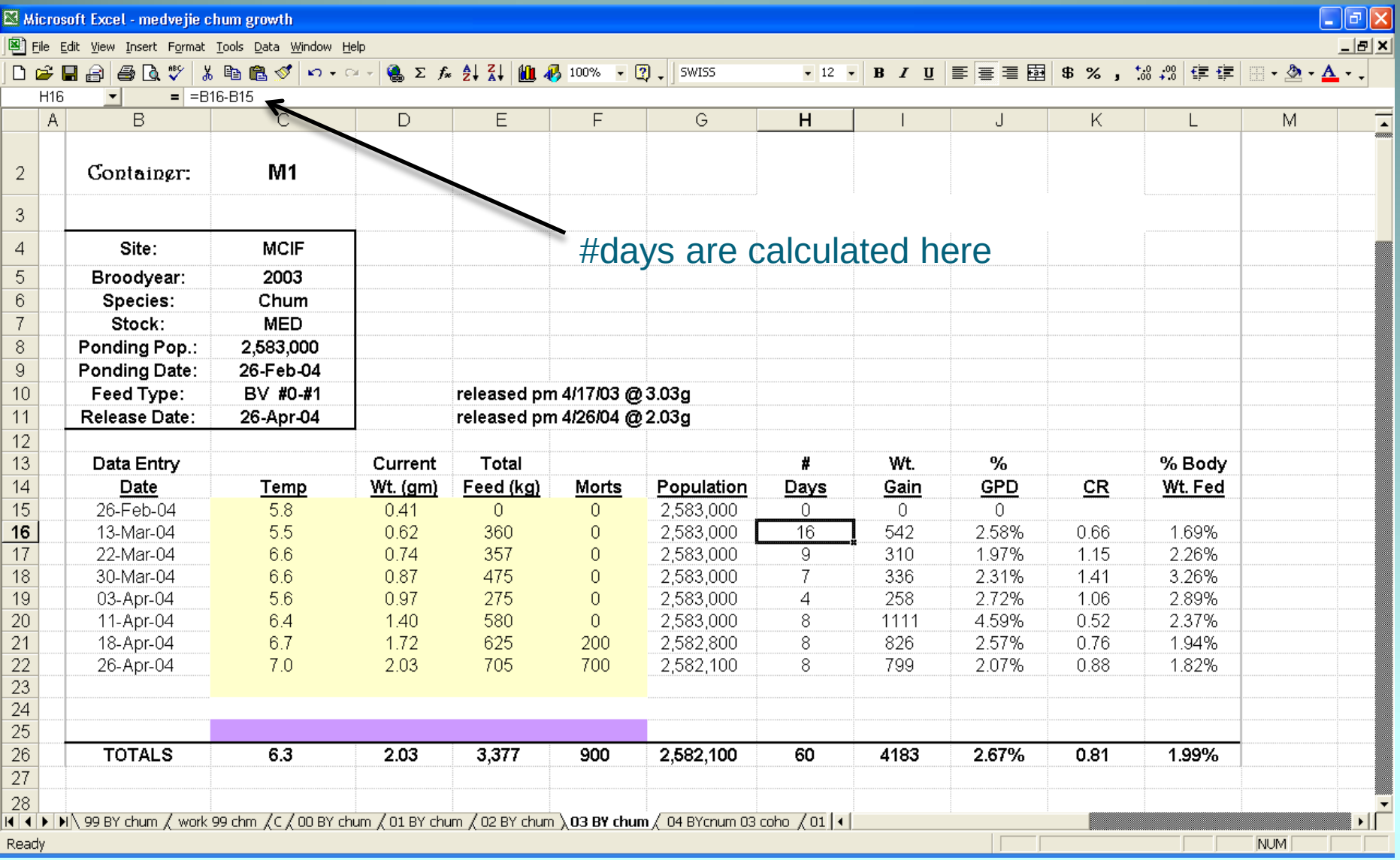
Production Planning

- 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…

Do you know your way around?

Formulas are typed into a spreadsheet program normally



Container:	M1	
Site:	MCIF	
Broodyear:	2003	
Species:	Chum	
Stock:	MED	
Ponding Pop.:	2,583,000	
Ponding Date:	26-Feb-04	
Feed Type:	BV #0-#1	released pm 4/17/03 @ 3.03g
Release Date:	26-Apr-04	released pm 4/26/04 @ 2.03g

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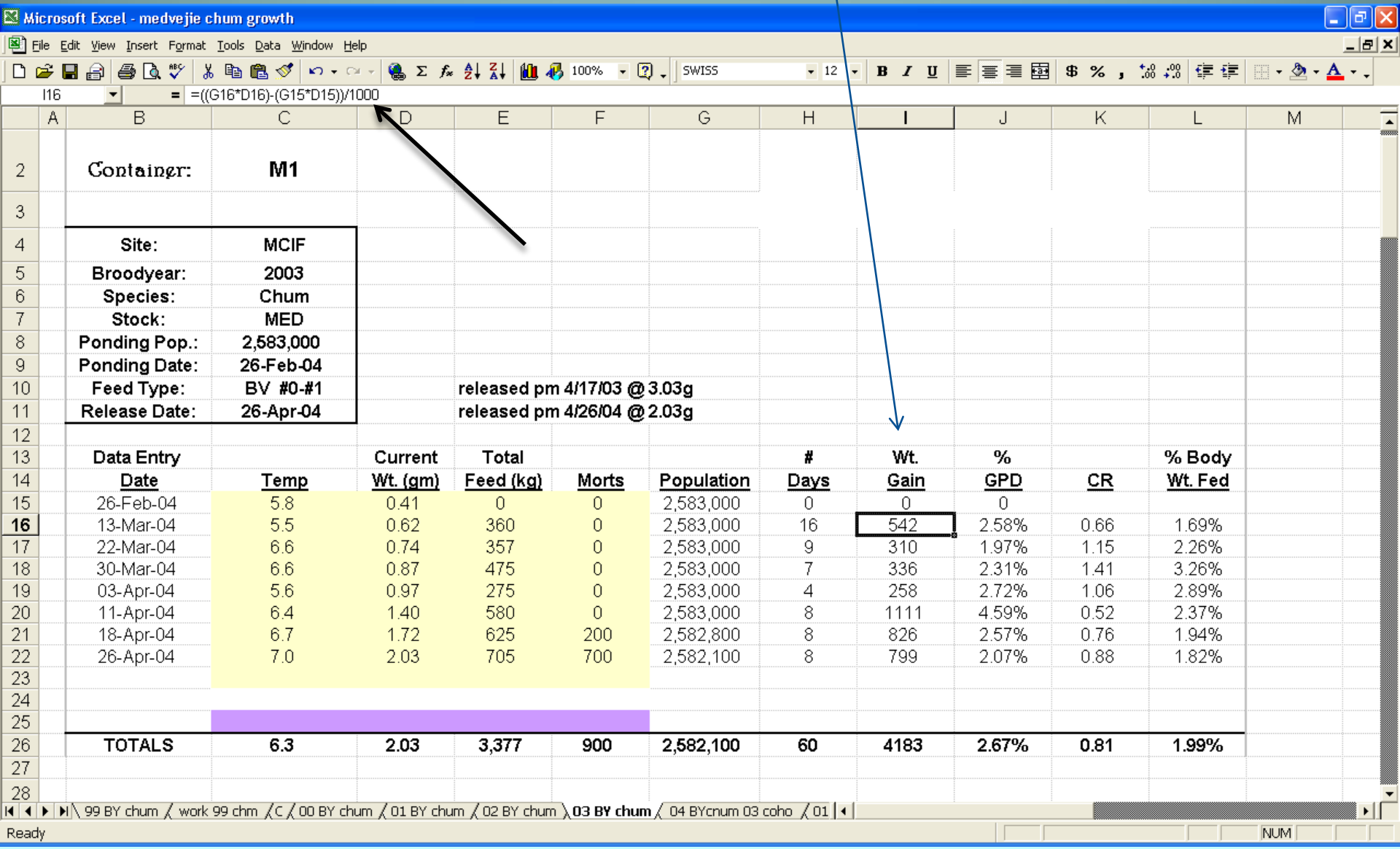
To calculate weight or biomass gain…



Microsoft Excel - medvejie chum growth

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I16 =((G16*D16)-(G15*D15))/1000

Container: **M1**

Site:	MCIF
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Species:	Chum
Stock:	MED
Ponding Pop.:	2,583,000
Ponding Date:	26-Feb-04
Feed Type:	BV #0-#1
Release Date:	26-Apr-04

released pm 4/17/03 @ 3.03g
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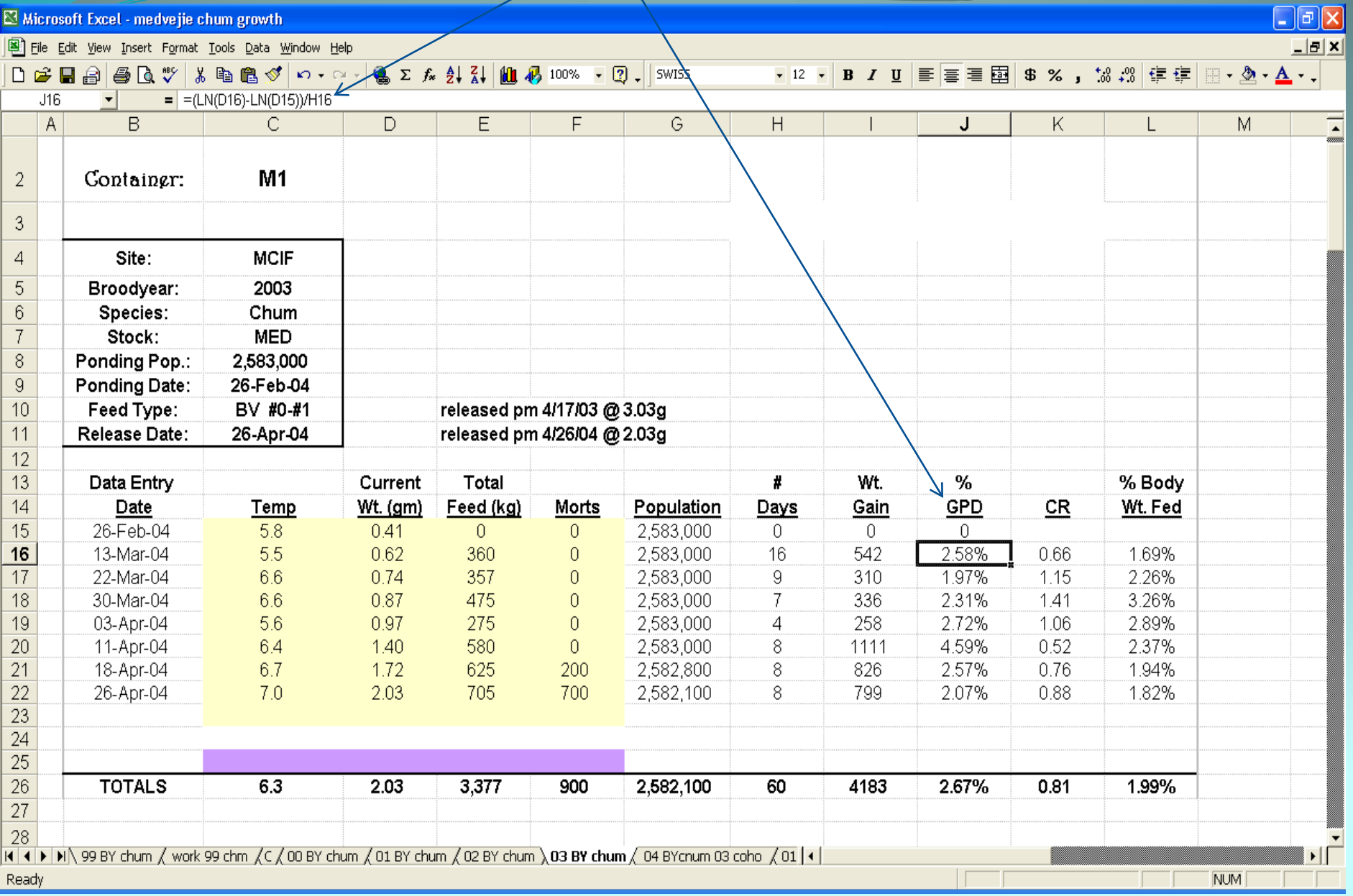
99 BY chum / work 99 chm / C / 00 BY chum / 01 BY chum / 02 BY chum / 03 BY chum / 04 BYcnum 03 coho / 01

Ready NUM

To calculate %gain per day…



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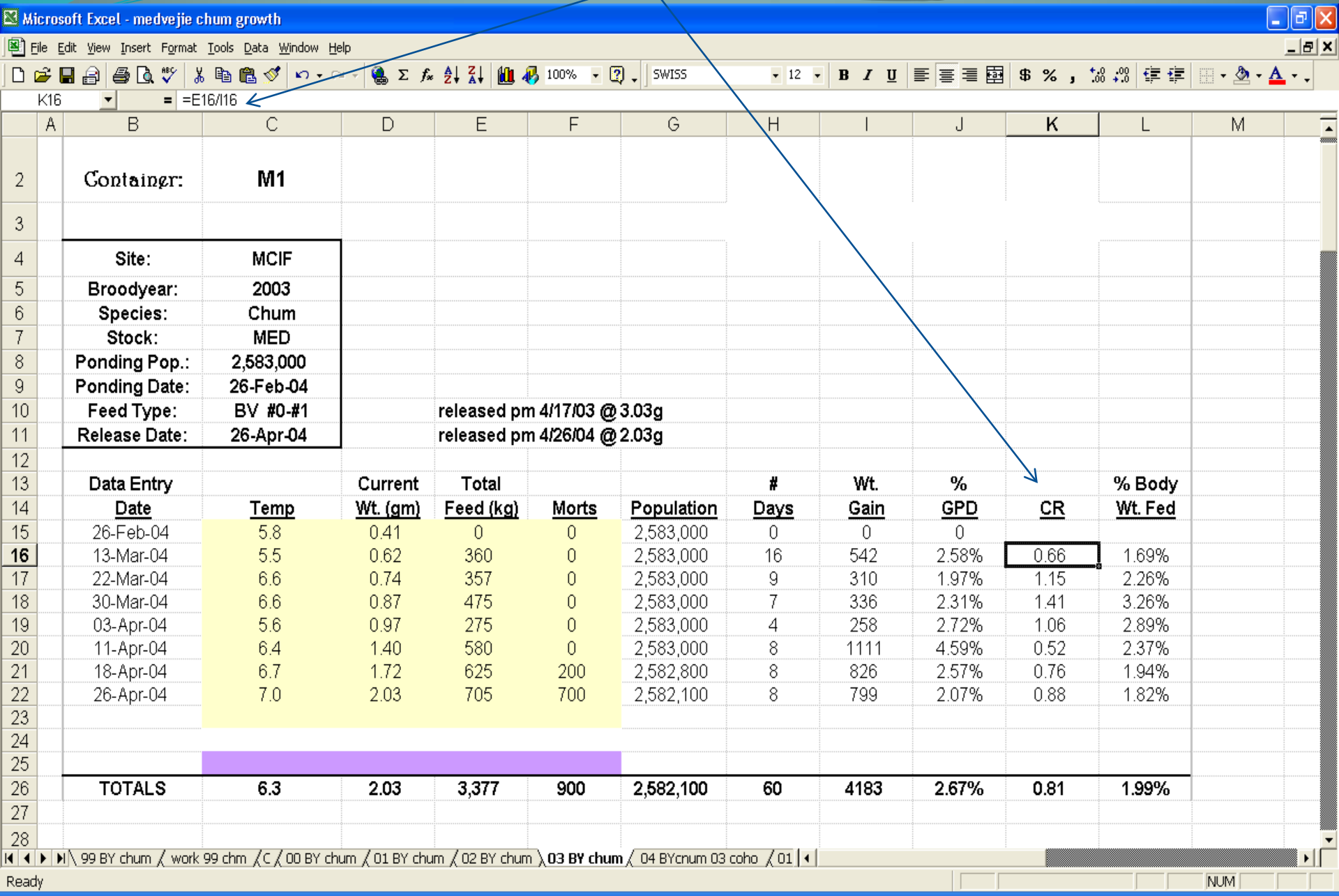
To calculate conversion rate…



Microsoft Excel - medvejie chum growth

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K16 =E16/I16

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Broodyear:	2003	
Species:	Chum	
Stock:	MED	
Ponding Pop.:	2,583,000	
Ponding Date:	26-Feb-04	
Feed Type:	BV #0-#1	released pm 4/17/03 @ 3.03g
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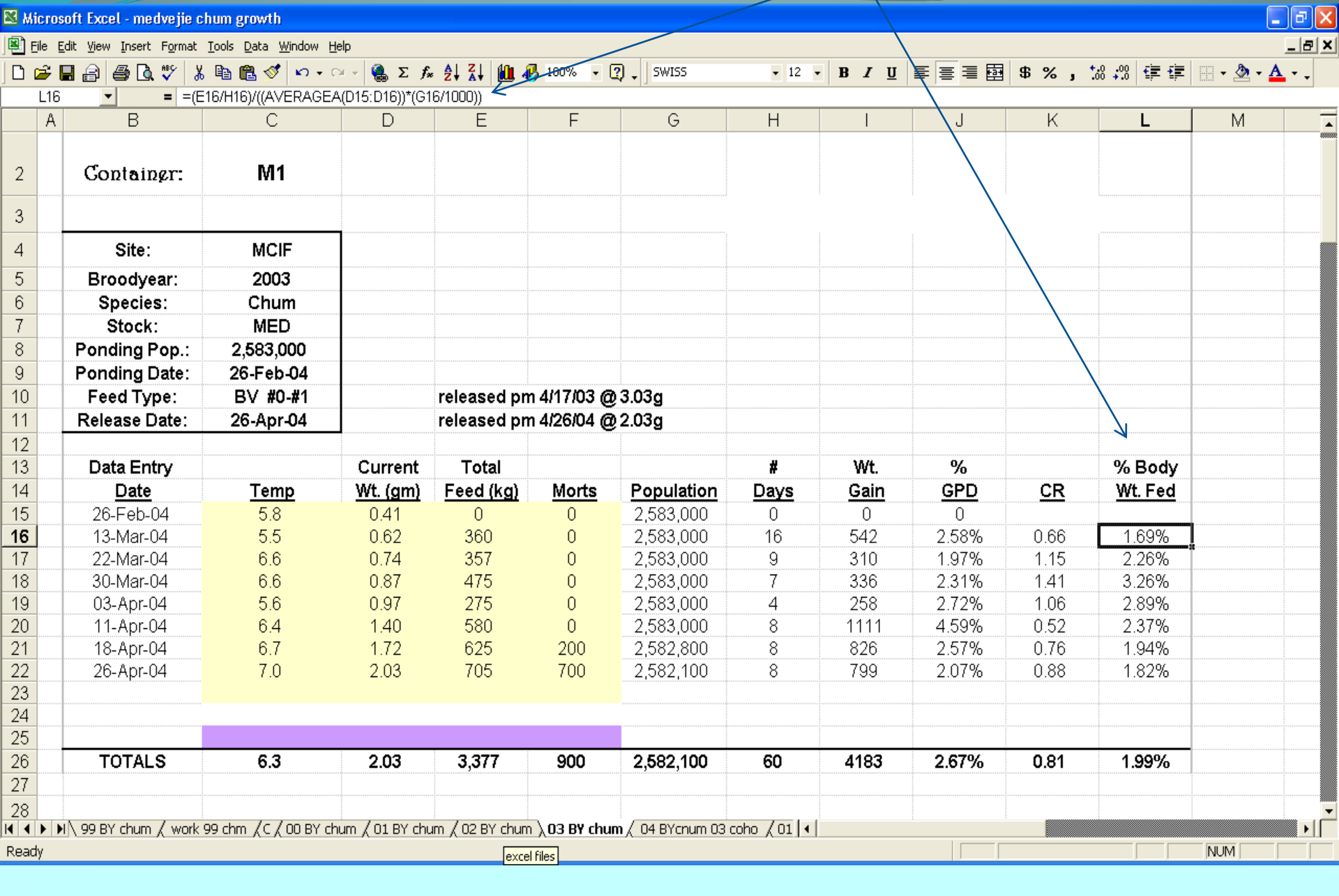
99 BY chum / work 99 chm / C / 00 BY chum / 01 BY chum / 02 BY chum / 03 BY chum / 04 BYcnum 03 coho / 01

Ready NUM

To calculate average % body weight fed…



Using performance data for budgeting purposes

Microsoft Excel - feed performance calculator

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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 3 due 2/9/15

- For this week find out how your facility samples fish. For example:
  - For various species: how often do they sample, how many fish/sample, how many replications?
  - Do they do any volumetric sampling?
  - If they raise fish in saltwater netpens, how do they catch them for sampling?
  - Maybe you have more questions?
  - **Post your findings to the Discussion Board**. Once posted, I'll enter credit.