Water Chemistry Overview

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What's the #1 fish killer in aquaculture?

Photo by Matt Recsetar/Dr. Travis Brown

- **Buy/hatch fish/shrimp + tap water + feed + harvest**
- **Profits!?**

Unfortunately not...

Knowing your water is one of the best things you can do!

Beginner farmer?.....

- Learn all you can about water chemistry
- Talk to Extension and other farmers
- Be a lifelong student
- Do your due diligence
  - **.edu!!!**

Unfortunately not...

If you're already in business……

- Buy healthy and hardy fish from a reputable dealer!
- Properly temper your fish!
- Check your parameters often and at key periods of time!
- Know your animal's **upper/lower/optimal** water quality limits!
- Maintain good records!
- Always be a lifelong student!

Key Periods of Time

1) Prevent loss of fish at stocking
2) Prevent loss during highest feeding rates (usually summer outdoors)
3) Prevent fish stress during harvest to minimize loss during transport and restocking

So what parameters are important?

Really depends on your system, species, density, etc.!

Ponds?

- Dissolved oxygen (DO)
- Temp.
- pH
- Total ammonia-nitrogen (TAN)
- Nitrite
- Alkalinity
- Hardness

Other parameters might be necessary

- ✓ Carbon dioxide
- ✓ Iron
- ✓ Chloride
- ✓ Hydrogen sulfide

So what parameters are important?

Really depends on your system, species, density, etc.!

Tanks (RAS)?

- Dissolved oxygen (DO)
- Temp.
- pH
- Total ammonia-nitrogen (TAN)
- Nitrite
- Carbon dioxide
- Alkalinity
- Iron (initially and then periodically)

So what parameters are important?

Really depends on your system, species, density, etc.!

Aquaponic System?

- Dissolved oxygen (DO)
- Temp.
- pH
- Total ammonia-nitrogen (TAN)
- Nitrite & Nitrate
- Alkalinity
- Carbon dioxide

Also recorded frequently in aquaponics

- ✓ Phosphorus
- ✓ Iron
- ✓ Calcium
- ✓ Potassium

Can’t I just check it every once in awhile???

Once again, unfortunately not...

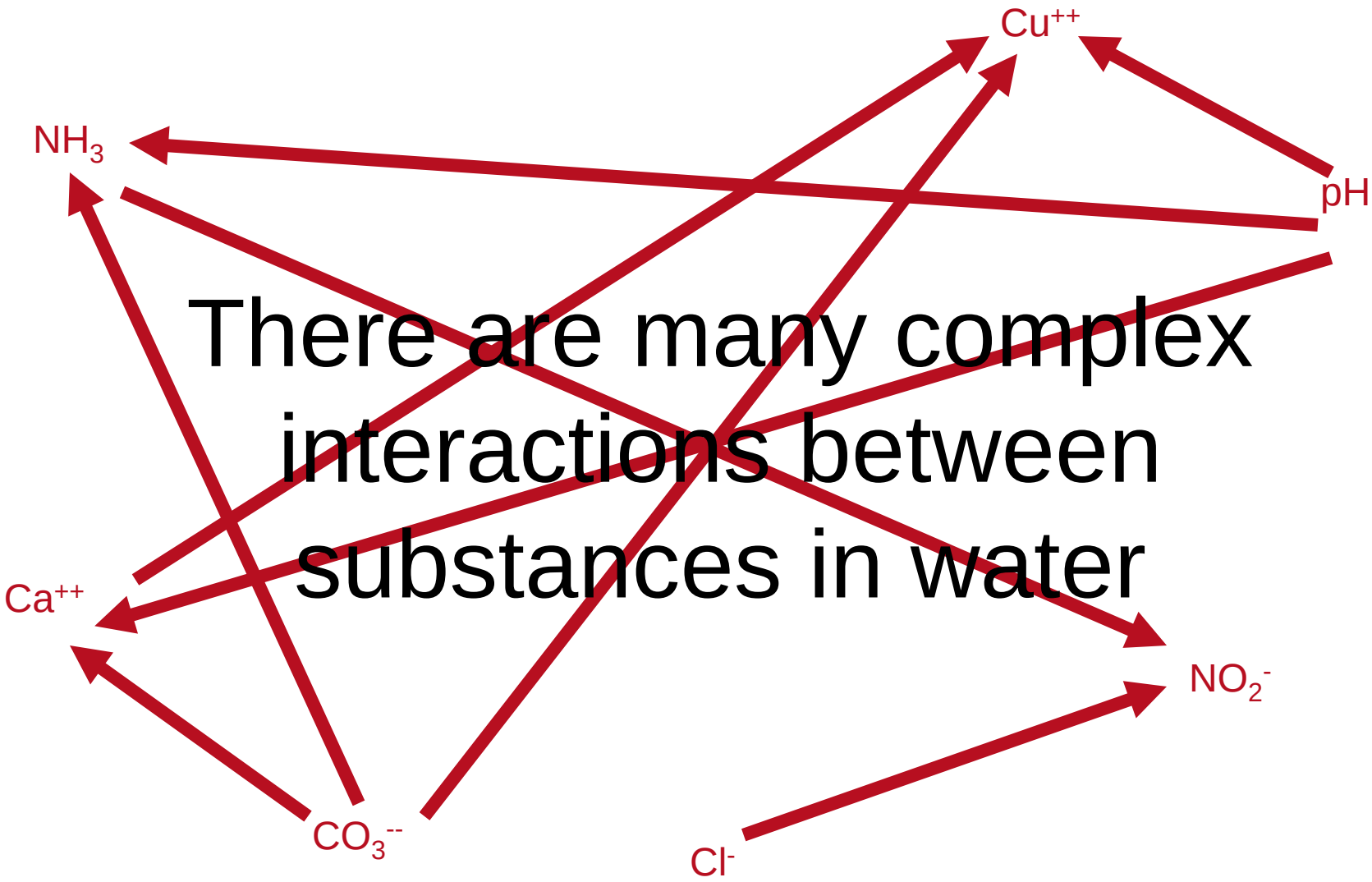
Daily testing!

Bi-weekly testing!

Bi-monthly testing!

Monthly testing!

Annual testing!



There are many complex interactions between substances in water

Yellow Perch Pond Example

Let's say you check your pH, temperature, and TAN in the **morning**. Say the levels are …..

Morning
8.4 pH
72°F
0.25 mg/L TAN
0.03 mg/L un-ion.
30 mg/L Alkalinity

Well that's not bad!

Yellow Perch Pond Example

Let's say you check your pH, temperature, and TAN in the **evening**. Say the levels are …..

Evening
9.8 pH
75°F
0.25 mg/L TAN
0.19 mg/L un-ion.
30 mg/L Alkalinity

Well that's **not** as good!

Yellow Perch Pond Example

My TAN didn't change! What happened?

It's because of that complex interaction I mentioned
The series of events went as followed

- ✓ DO is lowest in the morning
- ✓ DO increases as photosynthesis starts back
- ✓ CO_2 decreases due to plants using it up to produce O_2 as a by-product
- ✓ Removal of CO_2 **INCREASES** the pH due to the removal of acid
- ✓ **Increase in pH (& temp) shifts more** of the TAN into the un-ionized form
- ✓ Increase = stressed fish

Morning
8.4 pH
72°F
0.25 TAN
0.03 NH3 (un-ion.)

Evening
9.8 pH
75°F
0.25 TAN
0.19 NH3 (un-ion.)

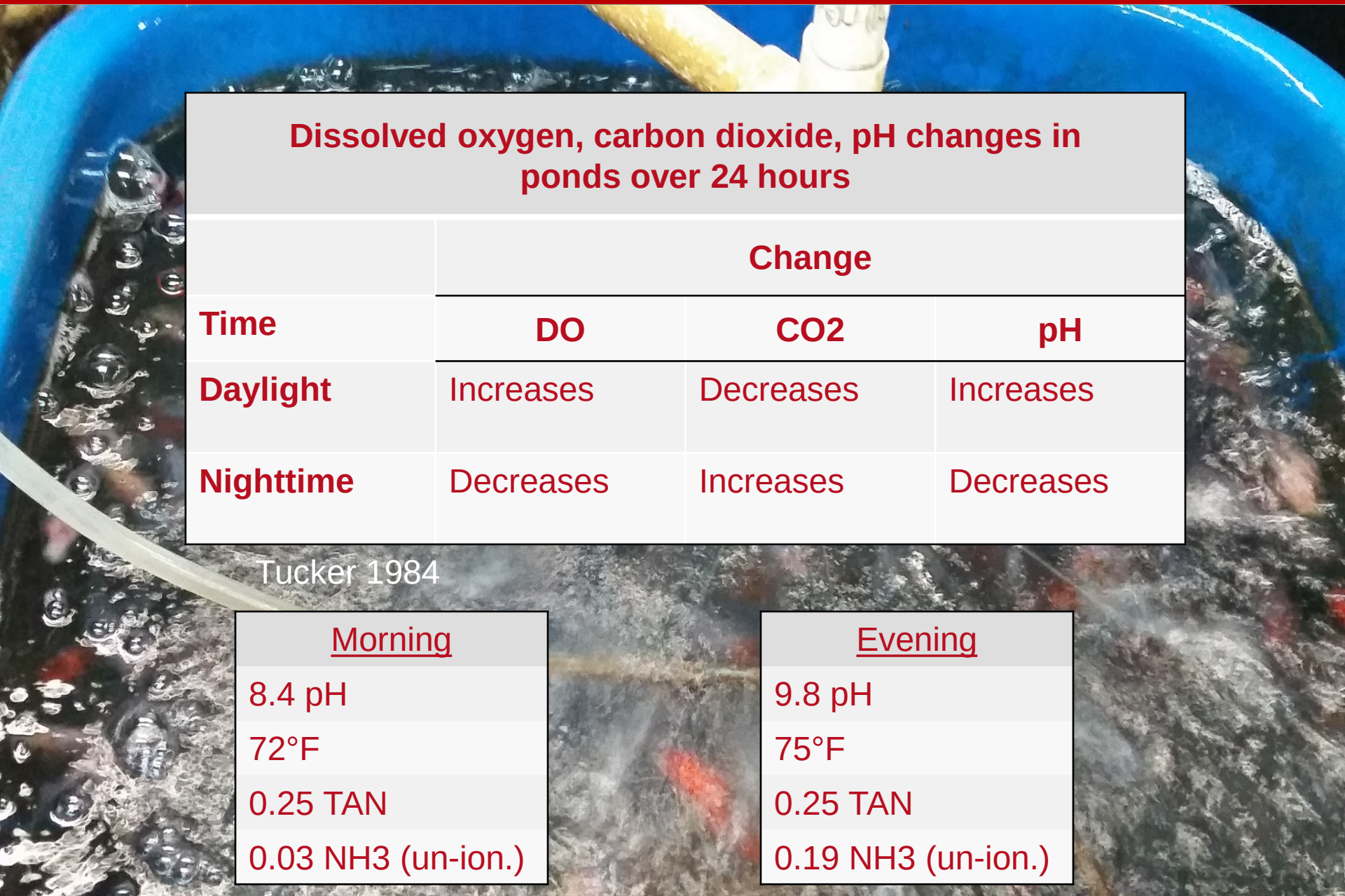
Un-ionized ammonia calculator

TAN, pH, and temperature need to be recorded AT THE SAME TIME in order to determine the amount present in your system

Table 2 Percentage Un-ionized Ammonia in Aqueous Solution by pH Value and Temperature
Calculated from data in Emerson, et. al*

	Temperature (°C)														
pH	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
7.0	0.11	0.13	0.16	0.18	0.22	0.25	0.29	0.34	0.39	0.46	0.52	0.60	0.69	0.80	0.91
7.2	0.18	0.21	0.25	0.29	0.34	0.40	0.46	0.54	0.62	0.82	0.83	0.96	1.10	1.26	1.44
7.4	0.29	0.34	0.40	0.46	0.54	0.63	0.73	0.85	0.98	1.14	1.31	1.50	1.73	1.98	2.26
7.6	0.45	0.53	0.63	0.73	0.86	1.00	1.16	1.34	1.55	1.79	2.06	2.36	2.71	3.10	3.53
7.8	0.72	0.84	0.99	1.16	1.35	1.57	1.82	2.11	2.44	2.81	3.22	3.70	4.23	4.82	5.48
8.0	1.13	1.33	1.56	1.82	2.12	2.47	2.86	3.30	3.81	4.38	5.02	5.74	6.54	7.43	8.42
8.2	1.79	2.10	2.45	2.86	3.32	3.85	4.45	5.14	5.90	6.76	7.72	8.80	9.98	11.29	12.72
8.4	2.80	3.28	3.83	4.45	5.17	5.97	6.88	7.90	9.04	10.31	11.71	13.26	14.95	16.78	18.77
8.6	4.37	5.10	5.93	6.88	7.95	9.14	10.48	11.97	13.61	15.41	17.37	19.50	21.78	24.22	26.80
8.8	6.75	7.85	9.09	10.48	12.04	13.76	15.66	17.73	19.98	22.41	25.00	27.74	30.62	33.62	36.72
9.0	10.30	11.90	13.68	15.65	17.82	20.18	22.73	25.46	28.36	31.40	34.56	37.83	41.16	44.53	47.91
9.2	15.39	17.63	20.08	22.73	25.58	28.61	31.80	35.12	38.55	42.04	45.57	49.09	52.58	55.99	59.31
9.4	22.38	25.33	28.47	31.80	35.26	38.84	42.49	46.18	49.85	53.48	57.02	60.45	63.73	66.85	69.79
9.6	31.36	34.96	38.38	42.49	46.33	50.16	53.94	57.62	61.17	64.56	67.77	70.78	73.58	76.17	78.55
9.8	42.00	46.00	50.00	53.94	57.78	61.47	64.99	68.31	71.40	74.28	76.92	79.33	81.53	83.51	85.30
10.0	53.44	57.45	61.31	64.98	68.44	71.66	74.63	77.35	79.83	82.07	84.08	85.88	87.49	88.92	90.19
10.2	64.53	68.15	71.52	74.63	77.46	80.03	82.34	84.41	86.25	87.88	89.33	90.60	91.73	92.71	93.58

* Emerson, K., R. C. Russo, R.E. Lund, and R.V. Thurston. 1975. Aqueous ammonia equilibrium calculations: effect of pH and temperature. *J. Fish. Res. Board Can.*, 32:2379-2383.



Dissolved oxygen, carbon dioxide, pH changes in ponds over 24 hours

	Change		
Time	**DO**	**CO2**	**pH**
Daylight	Increases	Decreases	Increases
Nighttime	Decreases	Increases	Decreases

Tucker 1984

Morning
8.4 pH
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Questions?

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