Appendix D

A Summary of Several Water Quality Parameters for six sites in the Finley National Wildlife Refuge, Oregon.

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Introduction

In spring 1998 a pesticide runoff study was initiated by the contaminant section of the Oregon State USFWS office. This investigation took place on the USFWS Finley Wildlife Refuge near Corvallis, Oregon. This report summarizes the water quality data collected using continuously monitoring Datasonde3 Hydrolab® units.

Methods

A Datasonde3 Hydrolab® was placed at six sites from February 9, 1998 to May 5, 1998. Each unit measured water temperature, dissolved oxygen (D.O.), pH, and specific conductance every hour. During data collection USFWS personnel cleaned, field checked and calibrated each unit on site every one to two weeks. In May, the data were downloaded into a spreadsheet.

A post-deployment equipment check was initiated to investigate differences among Hydrolab units. All six Hydrolabs were returned to the lab at the end of the study period and placed in room temperature standing water. Units recorded water quality information for three days. These recordings were downloaded, graphed, and visually assessed for variation among units. Since no independent measurements were taken, suspect data was compared to an average of the readings taken by the majority of the Hydrolab units.

Hydrolab data were plotted by date according to each water quality parameter and visually inspected for patterns. Two methods of data quality assurance/ data control (QA/QC) were completed following Oregon Department of Environmental Quality (ODEQ) protocols (ODEQ, 1997). The first QA/QC procedure tests the validity of the unit data by comparing field calibrations to Hydrolab readings for the same date. The following standards were utilized for each field audit parameter: +/- 1.5 temperature, +/- 0.3 pH, +/- 10% µS/cm specific conductance and +/- 1.0 mg/L D.O. If these conditions did not meet the allowed field audit range, the data were considered questionable**.**

The second QA/QC protocol compares the set-up values to the follow-up values (i.e. beginning of first audit to beginning of next audit). If the difference between each parameter of pH, specific conductance, and D.O. is greater than 0.3, 10% µS/cm and 1.0 mg/l respectively, then drift may have occurred and the data was to be considered suspect. Since drift is cumulative, adjustments cannot be accurately calculated.

After the data were evaluated, each parameter was compared to ODEQ state water quality standards as found in the Oregon Administrative Rules (OAR). Water quality standards are based on data collected from flowing waterbodies throughout Oregon. In this study, several sites contain standing water and ODEQ standards would not apply to these sites.

Results and Discussion

Temperature and specific conductance readings recorded in all six Hydrolabs revealed similar values in post deployment lab check (Figures 1 and 2). Four units measured similar pHs, while units used at Gray Cr. at cattail pond and Brown Cr. had different readings (Figure 3). Since no independent pH measurements were taken, the data was compared to the average reading of the four similar Hydrolabs. The Gray Cr. unit was just slightly

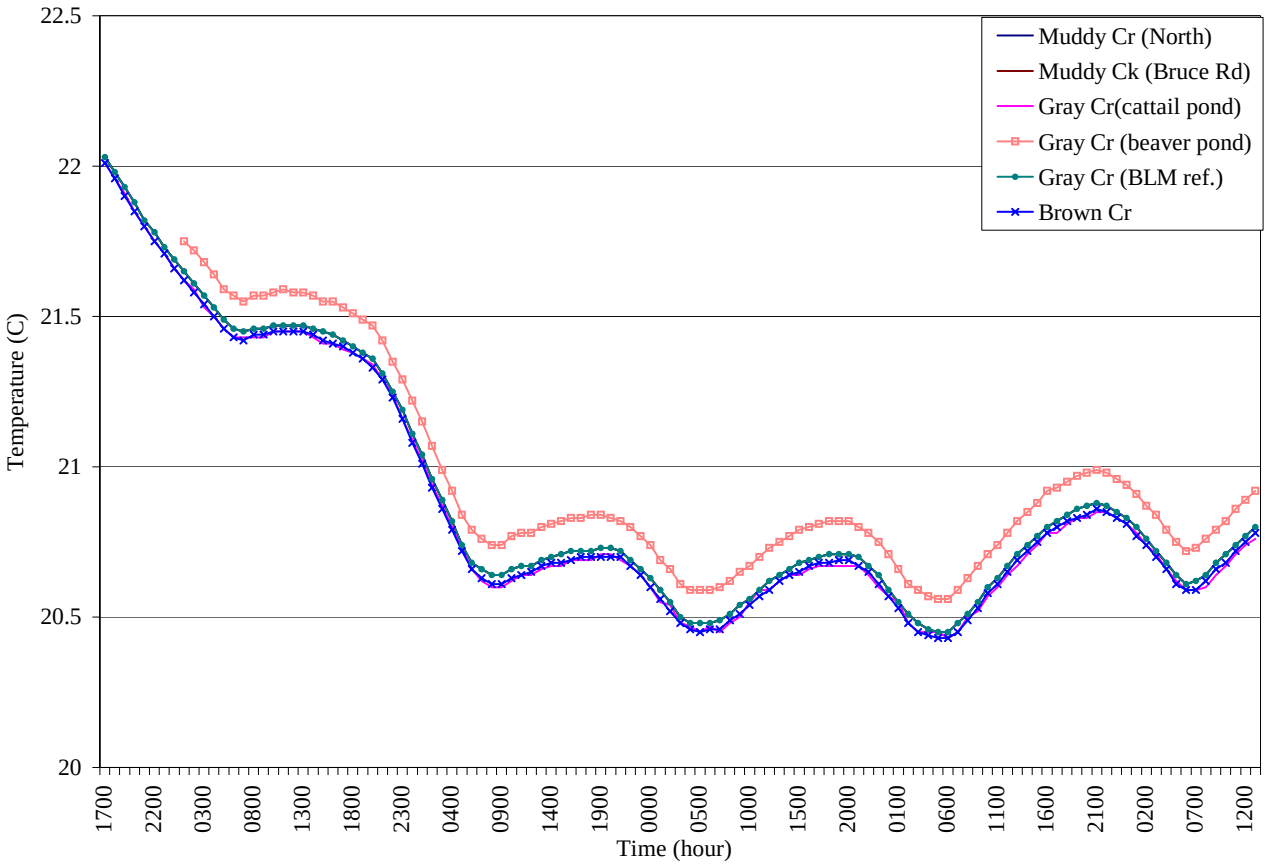

Figure 1. Temperature readings recorded as part of the post-deployment lab check for the six hydrolabs used in the Finley pesticide study. Hydrolabs were placed in a bucket filled with room temperature water for four days.

higher and the Brown Cr. unit was below average. Since both hydrolab readings were within $\pm$ 0.3 of the average reading, data could be used. However, the unit at Gray Cr. cattail pond did not pass the set-up/ follow-up QA check and therefore all pH data from this unit is questionable. Units from Gray Cr. at cattail pond and Brown Cr. also experienced problems recording D.O (Figure 4). The Gray Cr. unit readings are within the ODEQ audit standard; the greatest difference is less than 1.0 mg/L from the average. However, D.O. readings recorded from the Brown Cr. unit are more than 4.0 mg/l from average, D.O. data from this unit is questionable. Since no independent measurements

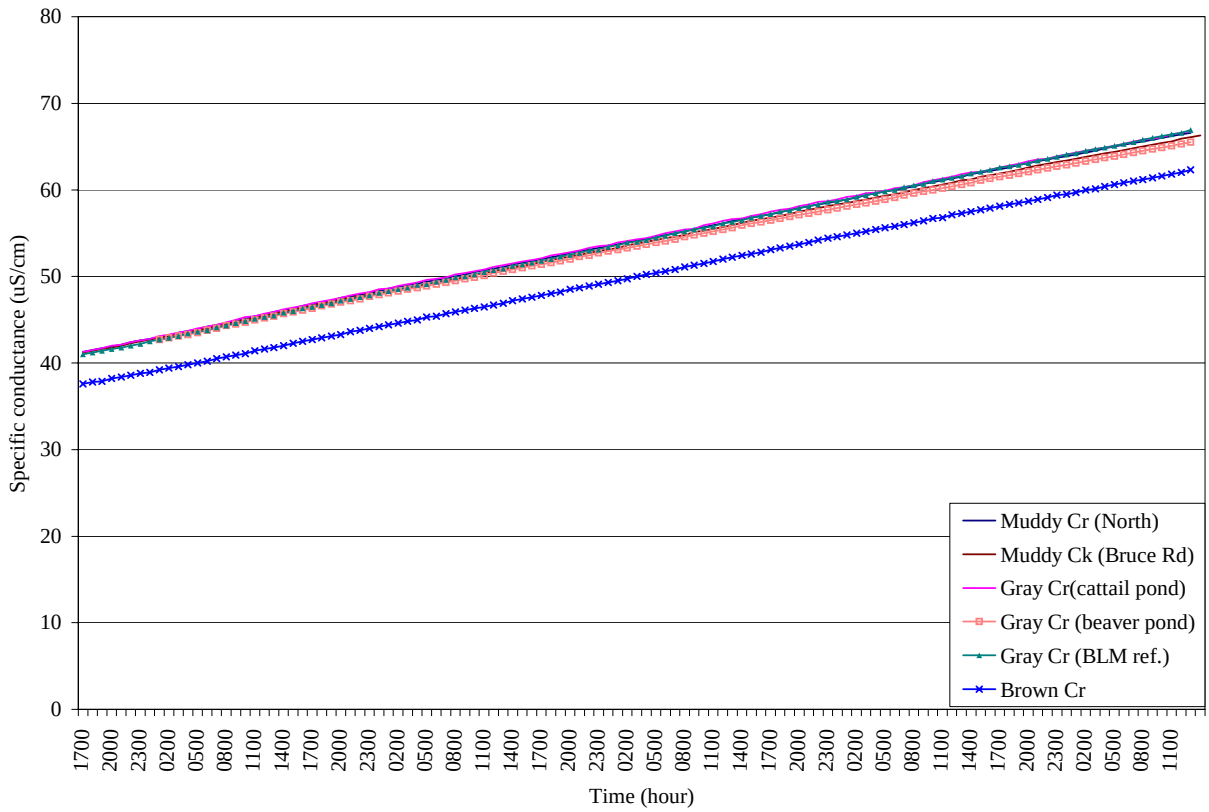

Figure 2. Specific conductance readings recorded as part of the post-deployment lab check for the six hydrolabs used in the Finley pesticide study. Hydrolabs were placed in a bucket filled with room temperature water for four days.

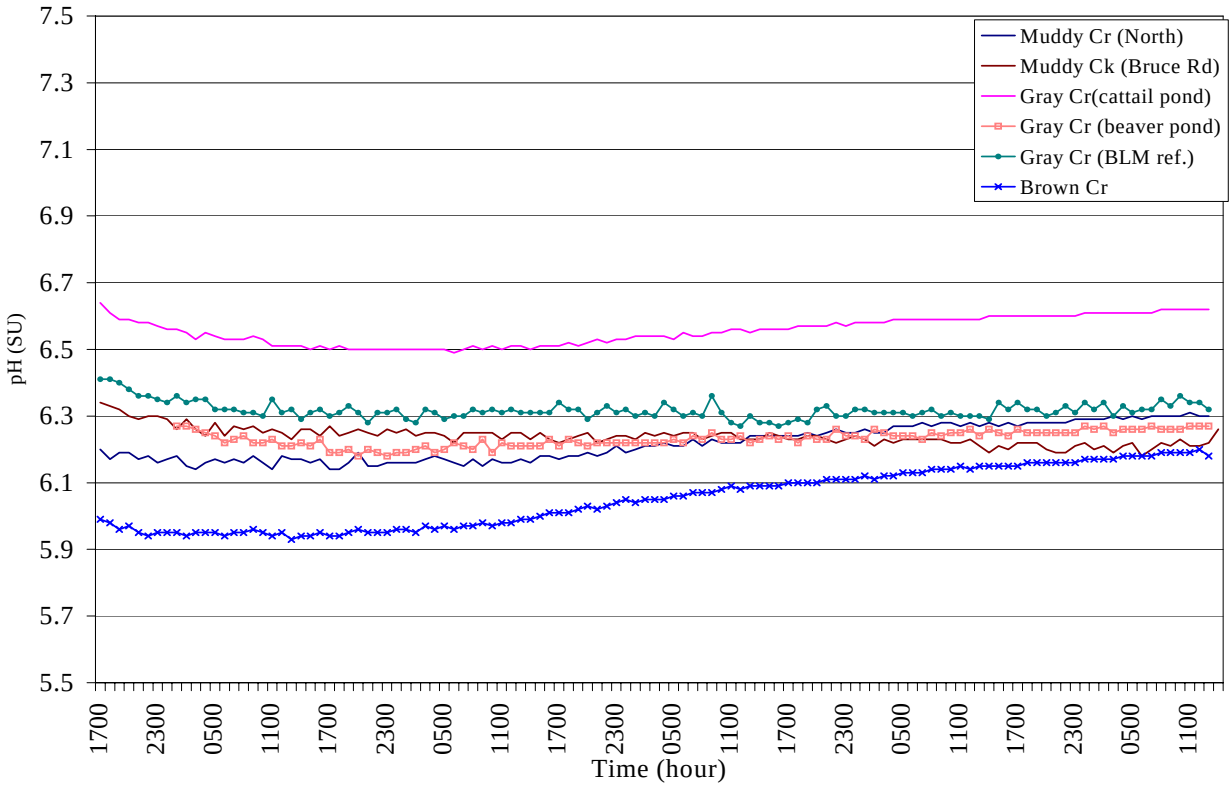

Figure 3. pH readings recorded as part of the post-deployment lab check for the six hydrolabs used in the Finley pesticide study. Hydrolabs were placed in a bucket filled with room temperature water for four days.

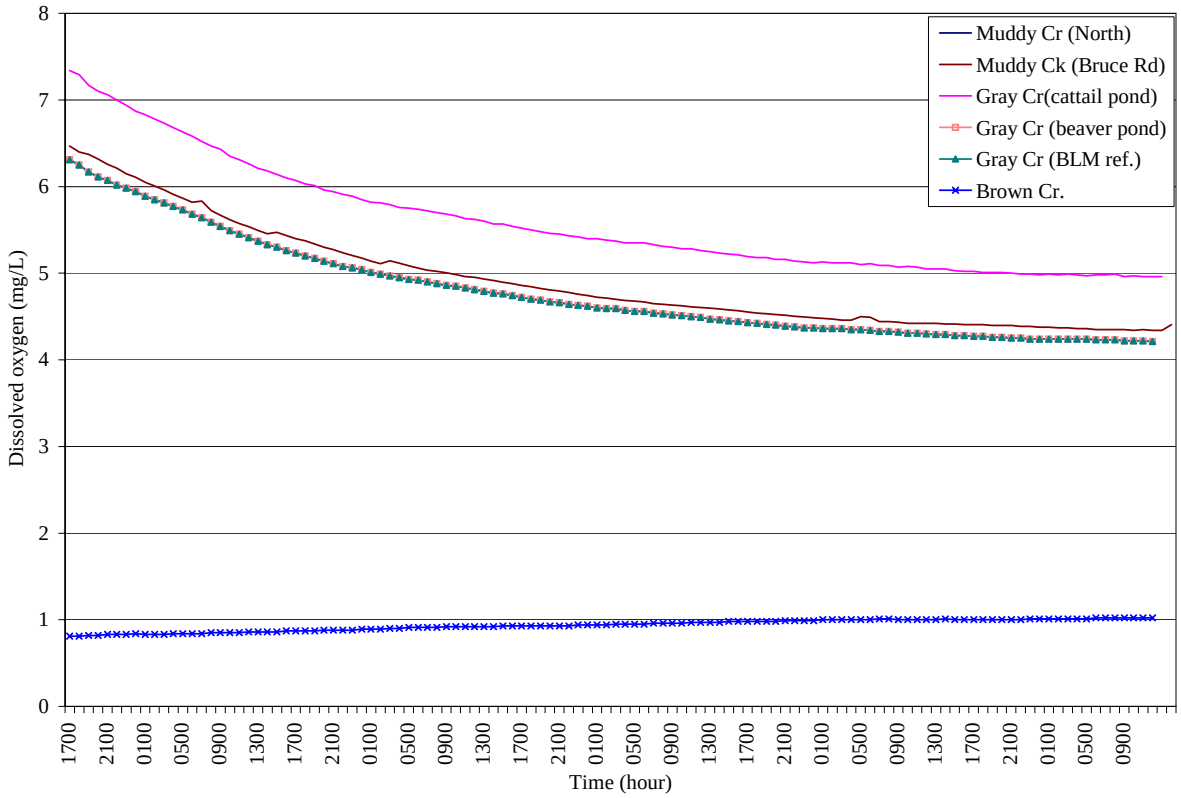

Figure 4. Dissolved oxygen (D.O.) readings recorded as part of the post deployment lab check for the six Hydrolabs used in the Finley pesticide study. Hydrolabs were placed in a bucket filled with room temperature water for four days.

were taken, all Brown Cr. D.O. values will be considered suspect and not discussed in this report.

Temperature. Water temperature is influenced by many factors such as riparian vegetation, hydrology, channel morphology, climate, geographic location as well as human influence (MacDonald et. al, 1991). Sites monitored in this study are ideal habitat for the Oregon chub (*Oregonichthys crameri*), a federally listed species. *O. crameri* is considered to be a species of intermediate tolerance to pollution and prefer water temperatures to be cool (Zaroban et. al, 1999). Although *O. crameri* is federally listed, Oregon does not have specific chemistry standards for this species. Instead, most criteria are based on salmonid tolerance levels, cold-water species with sensitive to intermediate tolerance. Since *O. crameri* is believed to be less sensitive than the Salmonidae family, state temperature criteria would also protect the Oregon chub.

Hydrolab temperature readings recorded at all sites were quite similar (Figures 5-7). However, at the end of the study period, as air temperatures increased, Gray Cr. at cattail ponds had higher temperature than all other sites. Gray Cr. at cattail pond also experienced higher diurnal temperature fluctuations. The extent to which stream temperatures change during a 24-hour period provides important information. Temperature fluctuations may be a function of ground water inputs, stream volume, stream shading, and human disturbance (MacDonald et. al, 1991). Biological responses to diel temperature changes vary between species so temperature refugia is an important consideration when

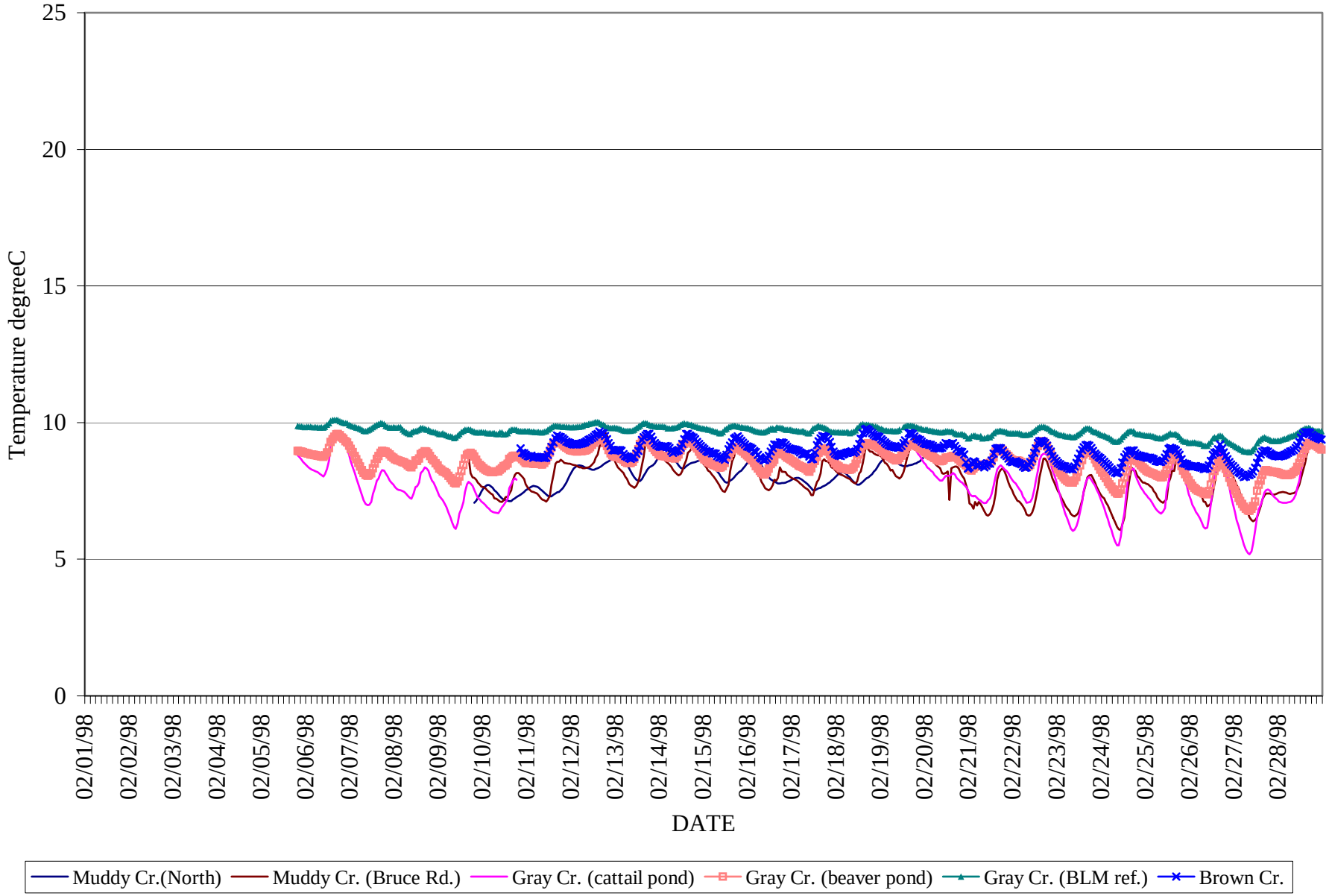

Figure 5. February Hydrolab temperature readings for six sites located in the Finley National Wildlife Refuge, Oregon. Gaps in data are due to battery failures.

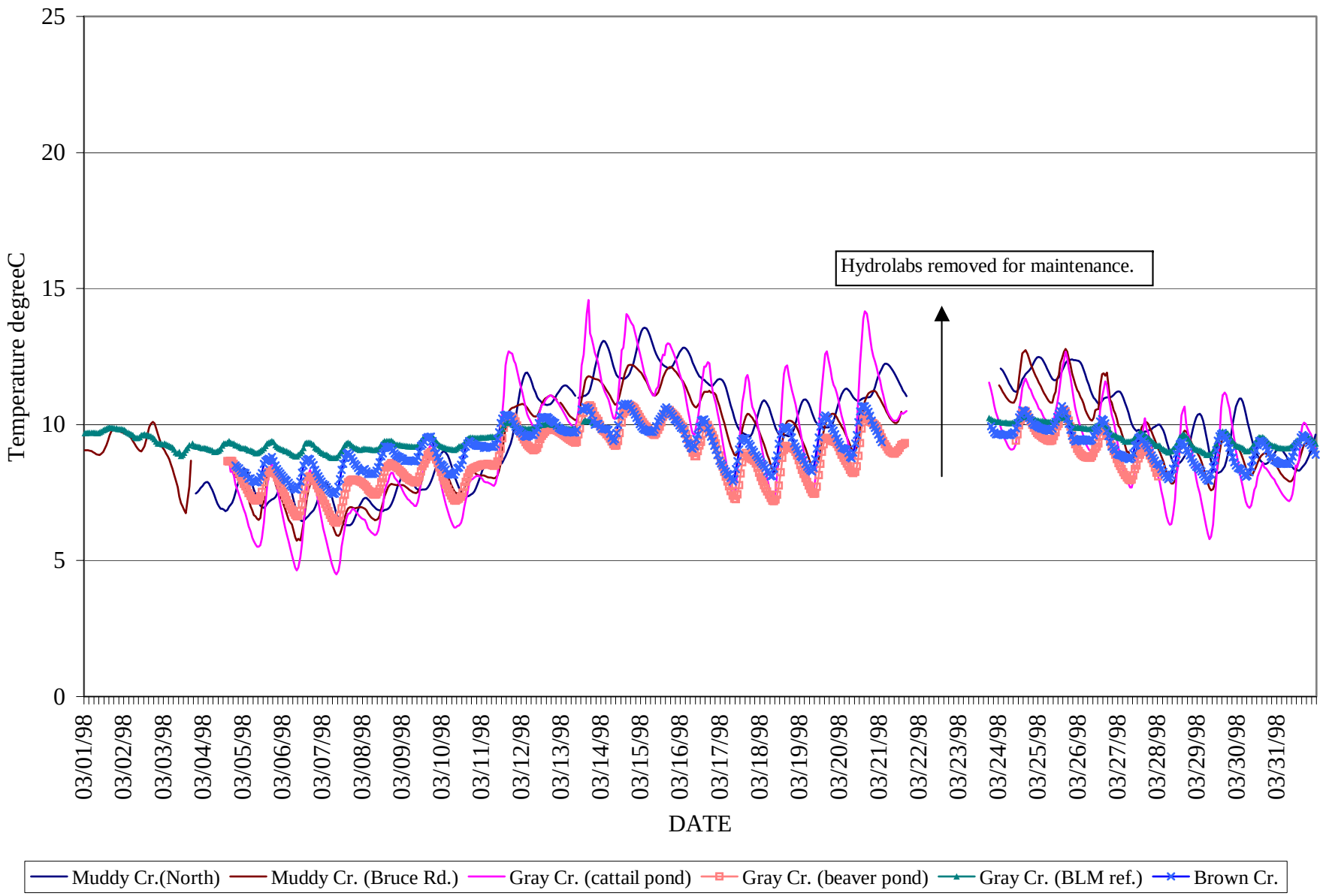

Figure 6. March Hydrolab temperature readings for six sites located in the Finley National Wildlife Refuge, Oregon. Gaps in data are due to battery failures or Hydrolab maintenance.

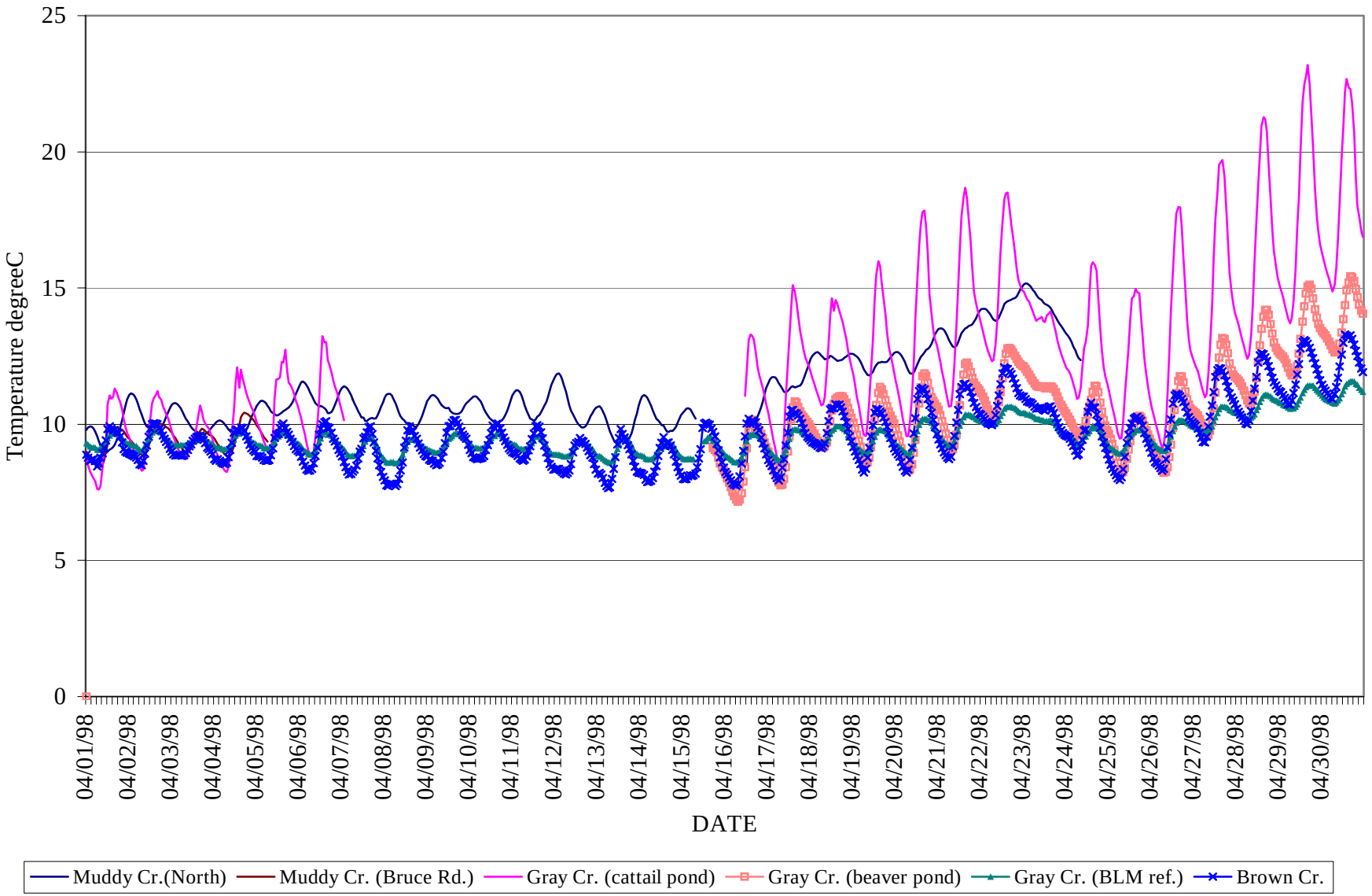

Figure 7. April hydrolab temperature readings for six sites located in the Finley National Wildlife Refuge, Oregon. Gaps in data are due to battery failures

evaluating species response. While Gray Cr. at the cattail pond had the largest diurnal temperature fluctuation, Gray Cr. at the BLM reference site experienced the lowest. This may have several natural explanations. Most likely, the reference site is a well shaded flowing stream and as such is not exposed to solar heating. Gray Cr. at the cattail pond appears to be an open, slow-moving system. Daily temperature fluctuations were probably due to increased exposure to solar irradiation which would warm the water and since it was slow-moving, this site acts more like a pond than a lotic system.

The calculated seven-day moving average temperature matches individual Hydrolab readings. Based on the seven-day moving average for the sampled time period (Table 1), only Gray Cr. at the cattail ponds violated the statewide temperature standard of 64 °F/17.8 °C (OAR 340-41-445-(2)(b)(A)i). Gray Cr. at the cattail pond also had the largest seven-day moving average maximum ΔT.

Table 1. Calculated seven-day moving average temperature (°C) and change in daily temperature (ΔT) for six sites on the Finely Wildlife Refuge (Willamette Valley, Oregon). Data were recorded using Datsonde3 Hydrolab units February 6 through May 5, 1998.

Site Name	7- day average maximum temp. (°C)	7-day average maximum ΔT
Muddy Cr. (North)	14	2.3
Muddy Cr. (Bruce Rd.)	11.5	1.9
Gray Cr. (cattail pond)	19.4	7.8
Gray Cr. (beaver pond)	13.1	3.0
Gray Cr. (BLM ref.)	10.7	0.9
Brown Cr.	11.9	2.5

Specific conductance. Specific conductance is a measure of the electrical conductance of water and an estimate of total dissolved ions. There are no statewide standard for specific conductance, however, in many cases it can be also be used as surrogate for human distance (MacDonald et. al, 1991). Gray Cr. at beaver pond had the lowest specific conductance and Gray Cr. at cattail pond had the highest (Figures 8-10). In February, the specific conductance levels in Brown Cr. rose approximately 45 μS/cm (Figure 8). Field notes do not indicate the unit was removed from the water only that "farmers are applying chemicals to the refuge fields this week and goose-collar readers have observed backpack spraying on adjacent Christmas tree farms on 2/22/98." Precipitation (1.19 in) was also recorded at the Hyslope Experimental Station in Corvallis on 2/22/98. It may be possible that the jump in specific conductance at Brown Cr. is due to a combination of these events. During the highest precipitation event of the sampling period, 2.07 in on 3/22/98, the Hydrolabs were all removed for maintenance. In April, specific conductance rose about 20 uS/cm at the Muddy Cr. (North) site (Figure 10). There was less than 0.5 in recorded precipitation and no abnormalities recorded in the field notes.

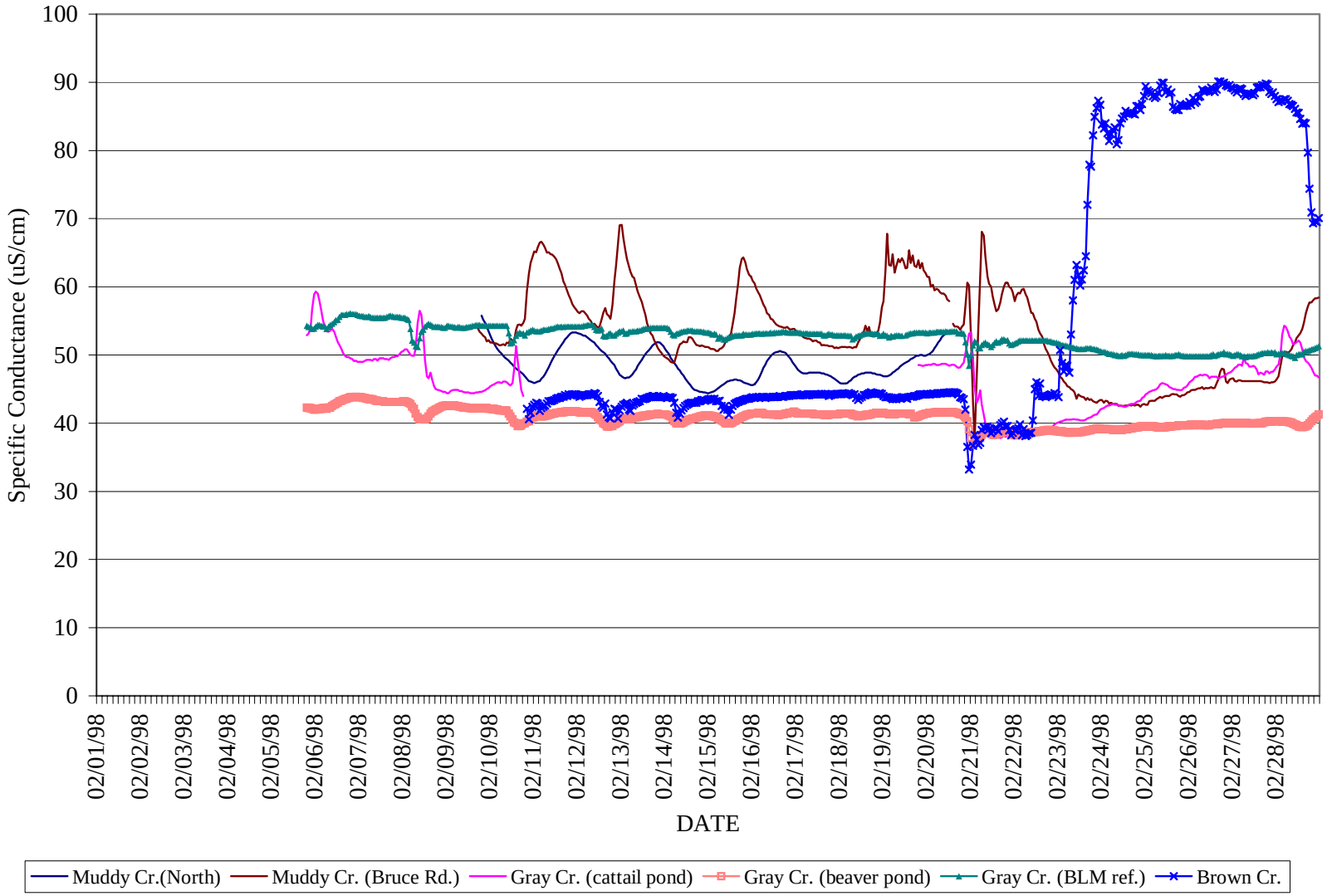

Figure 8. February hydrolab specific conductance readings for six sites located in the Finley National Wildlife Refuge, Oregon. Gaps in data are due to battery failures

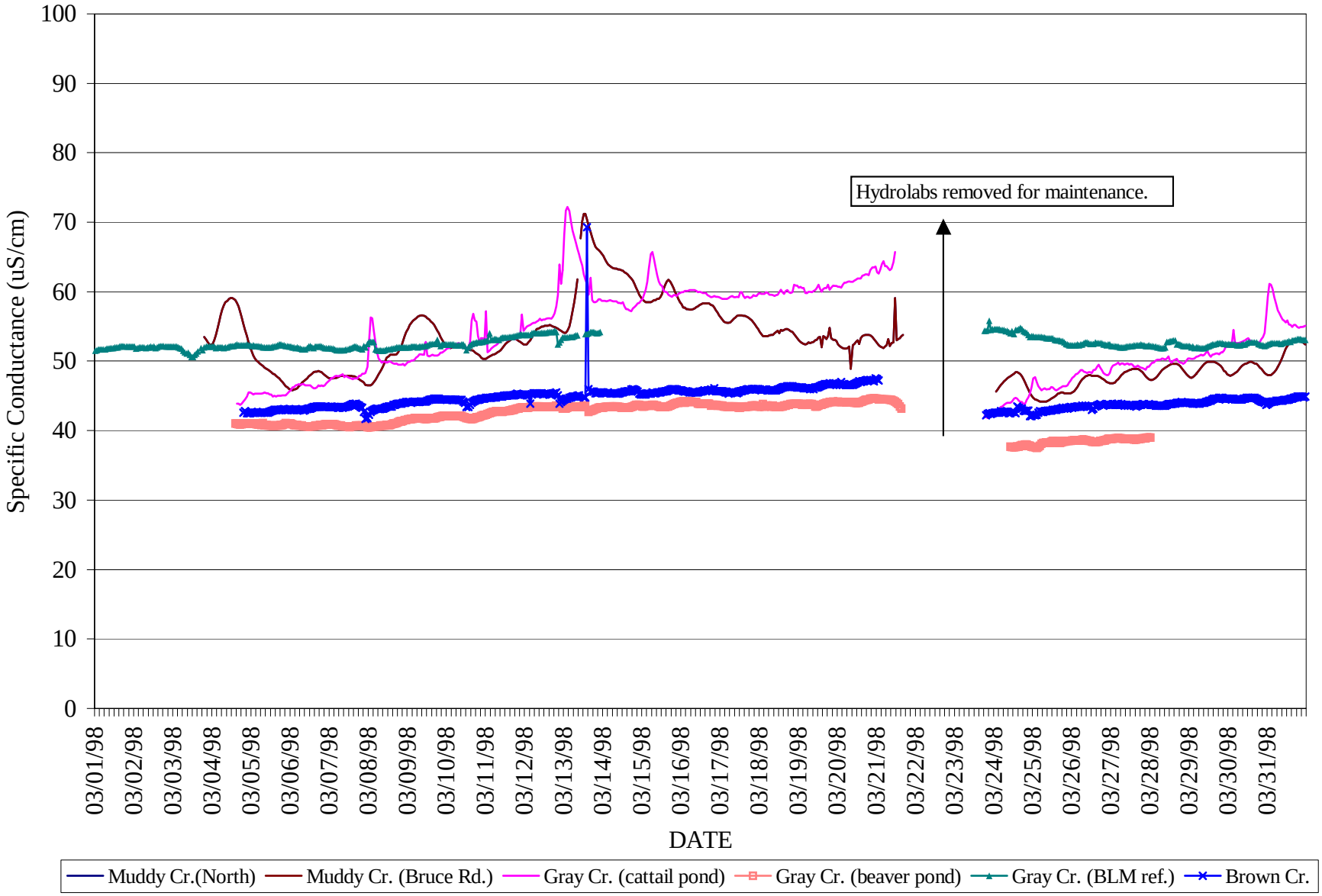

Figure 9. March Hydrolab specific conductance readings for six sites located in the Finley National Wildlife Refuge, Oregon. Gaps in data are due to battery failures and Hydrolab maintenance.

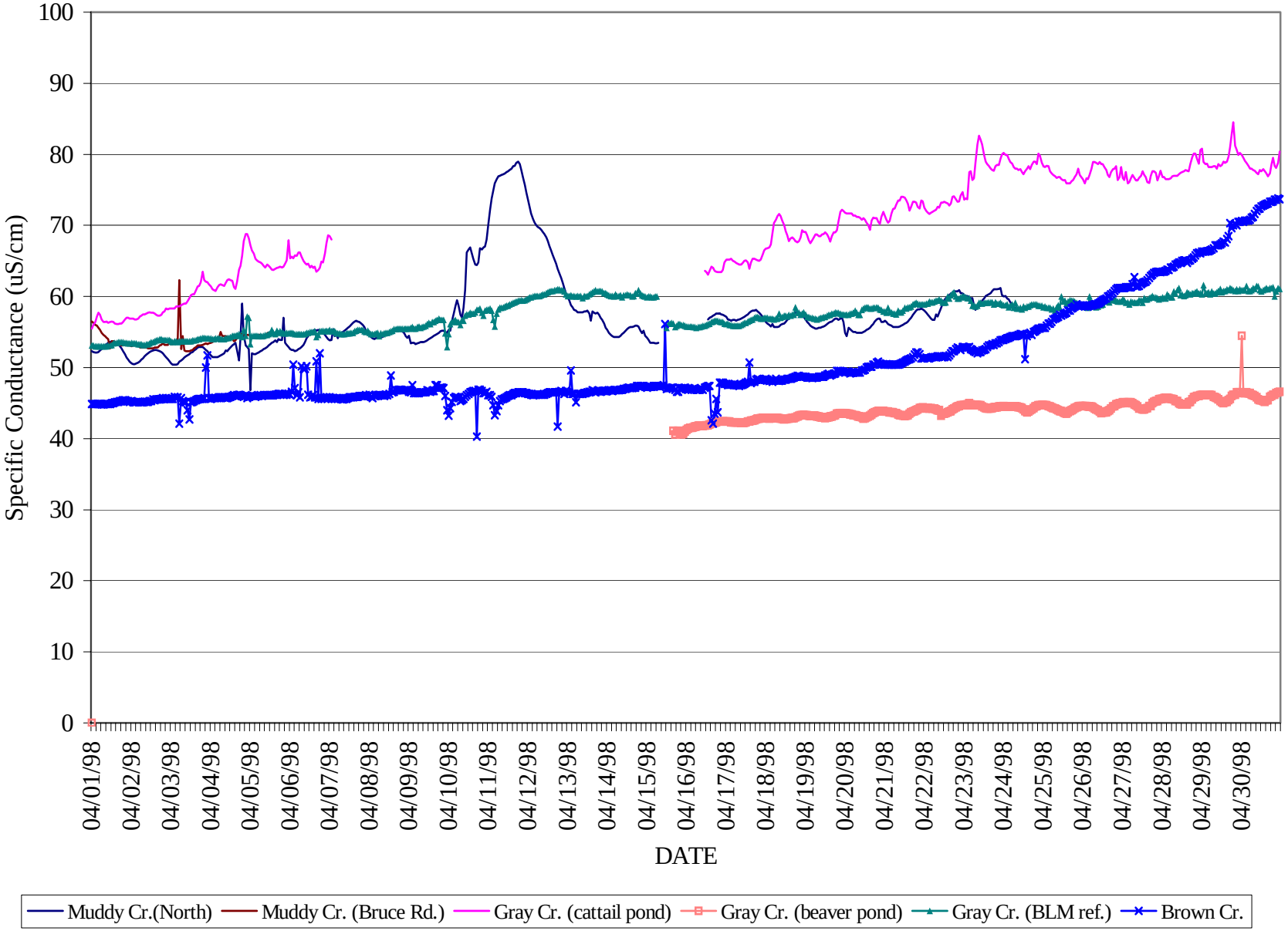

Figure 10. April Hydrolab specific conductance readings for six sites located in the Finley National Wildlife Refuge, Oregon. Gaps in data are due to battery failures.

pH. Natural levels of pH in streams and rivers are between 6.0 and 8.5 (Stumm and Morgan 1996) and ODEQ has set the pH standard for cool water aquatic life in the Williamette basin between 6.5 and 8.5 (OAR 340-41-445-(2)(d)E). Daily pH fluctuations occur naturally, and pH values are often greater in the afternoon when photosynthetic activity is higher (Stumm and Morgan 1996). Larger fluctuations could indicate more algae, which can be related to less shading and elevated nutrient input.

Hydrolab pH readings were variable for all sites (Figures 11-13). After all hydrolabs were removed for maintenance in late March, five units read almost 0.5 SU lower than before they had been removed from the water. This variation in data could be due to drift and without verification of field results it is not possible to correct the pH values. Since such variability exists in the data, it would not be appropriate to use these data to compare to Willamette Basin standards. However, it is possible to evaluate pH readings based on daily fluctuations. Along with the temperature data, Gray Cr. at the cattail pond had the largest diel fluctuation and Gray Cr. at the BLM reference site recorded the lowest pH daily change. Again this is most likely due to natural reasons.

Dissolved oxygen. Most cold water fish prefer D.O. levels between 8 and 12 mg/L (Wydoski and Whitney 1979)). ODEQ statewide standards state that "For waters identified as providing cool-water aquatic resources, the dissolved oxygen shall not be less than 6.5 mg/l" (OAR 340-41-445-(2)a(A)). Disregarding the Brown Cr. D.O. readings (which did not pass the 'post deployment'check), all sites fall within the Willamette Basin cool-water D.O criteria (Figures 14-16). Like the temperature and pH data, Gray Cr. at the cattail pond had the largest daily D.O. fluctuations and Gray Cr. at the BLM reference site had the lowest change. Larger diurnal fluctuations could be related to the amount of solar input, temperature and algal growth in a system.

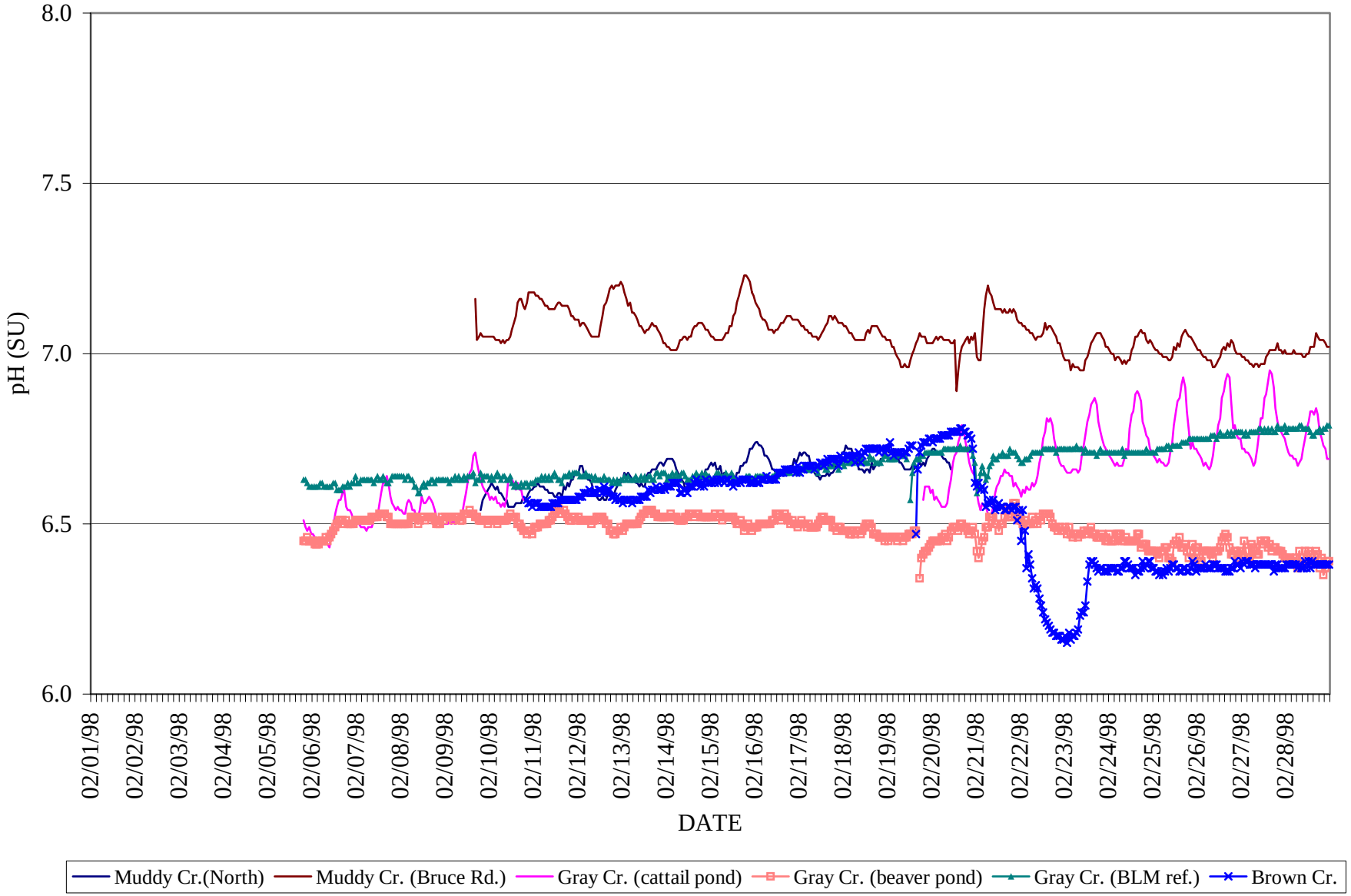

Figure 11. February Hydrolab pH readings for six sites located in the Finley National Wildlife Refuge, Oregon. Gaps in data are due to battery failures.

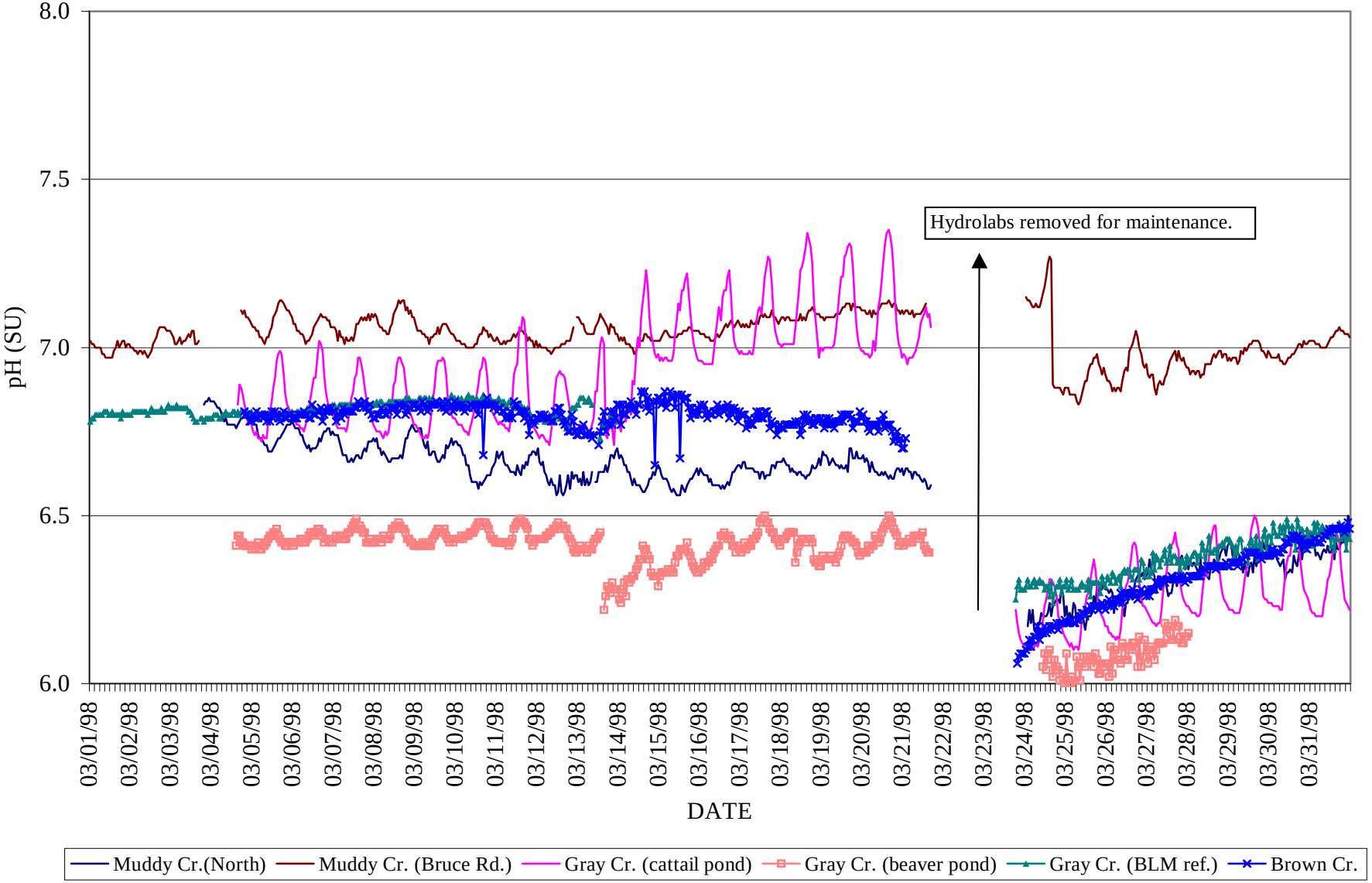

Figure 12. March Hydrolab pH readings for six sites located in the Finley National Wildlife Refuge, Oregon. Gaps in data are due to battery failures and Hydrolab maintenance.

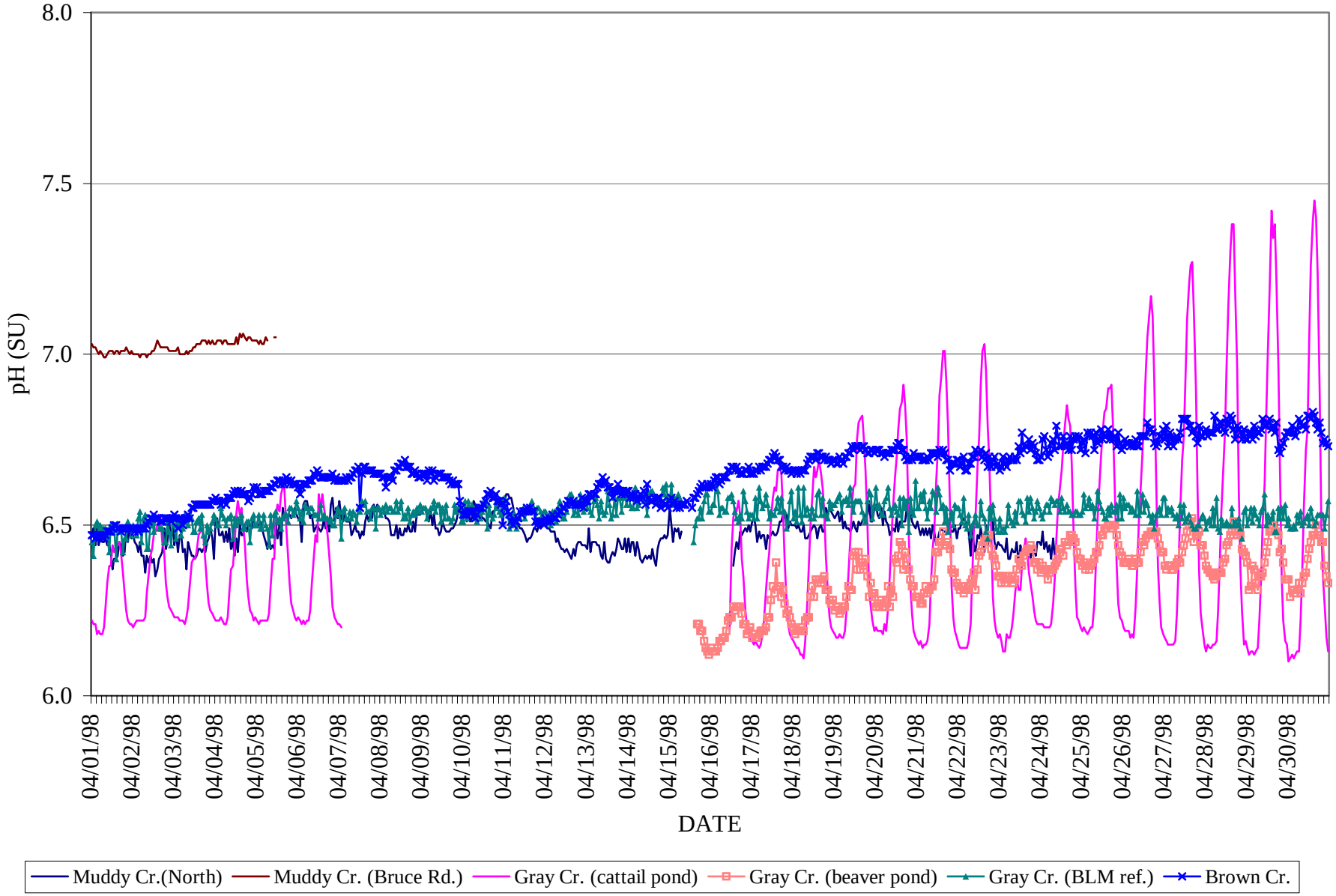

Figure 13. April hydrolab pH readings for six sites located in the Finley National Wildlife Refuge, Oregon. Gaps in data are due to battery failures.

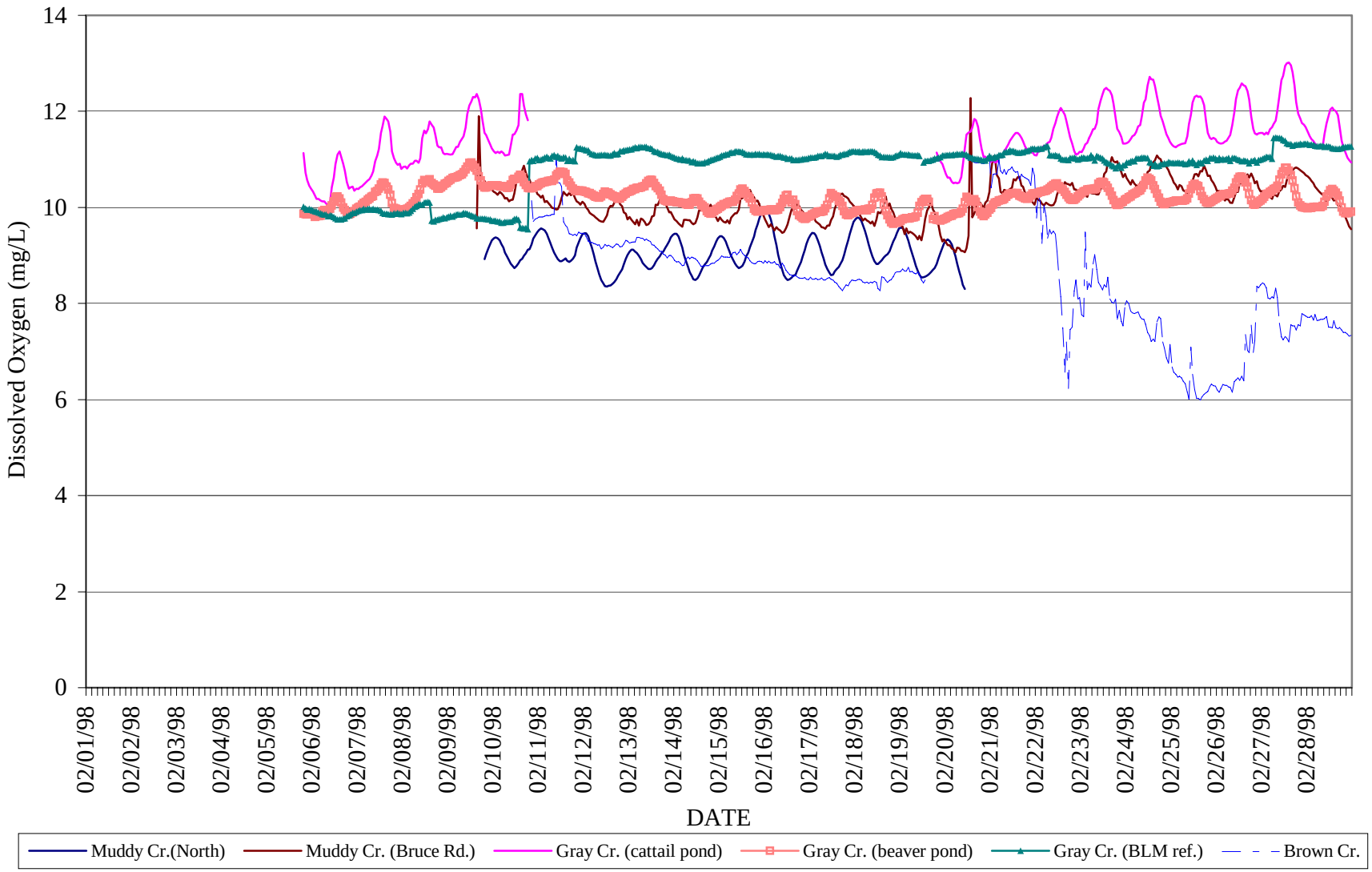

Figure 14. February Hydrolab D.O. readings for six sites located in the Finley National Wildlife Refuge, Oregon. Gaps in data are due to battery failures. Brown Cr. D.O. measurements are suspect.

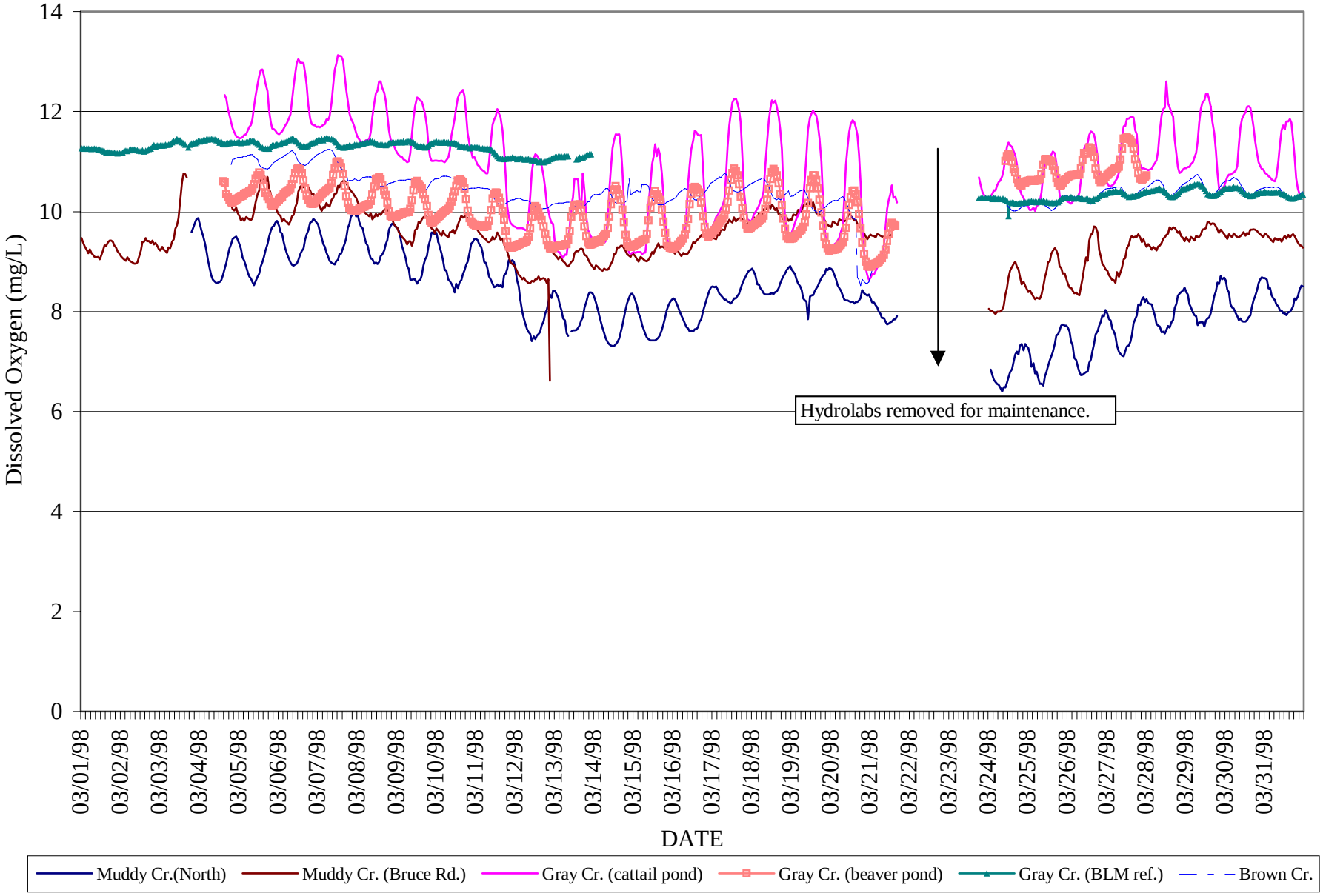

Figure 15. March Hydrolab D.O. readings for six sites located in the Finley National Wildlife Refuge, Oregon. Gaps in data are due to battery failure and Hydrolab maintenance. Brown Cr. D.O. measurements are suspect.

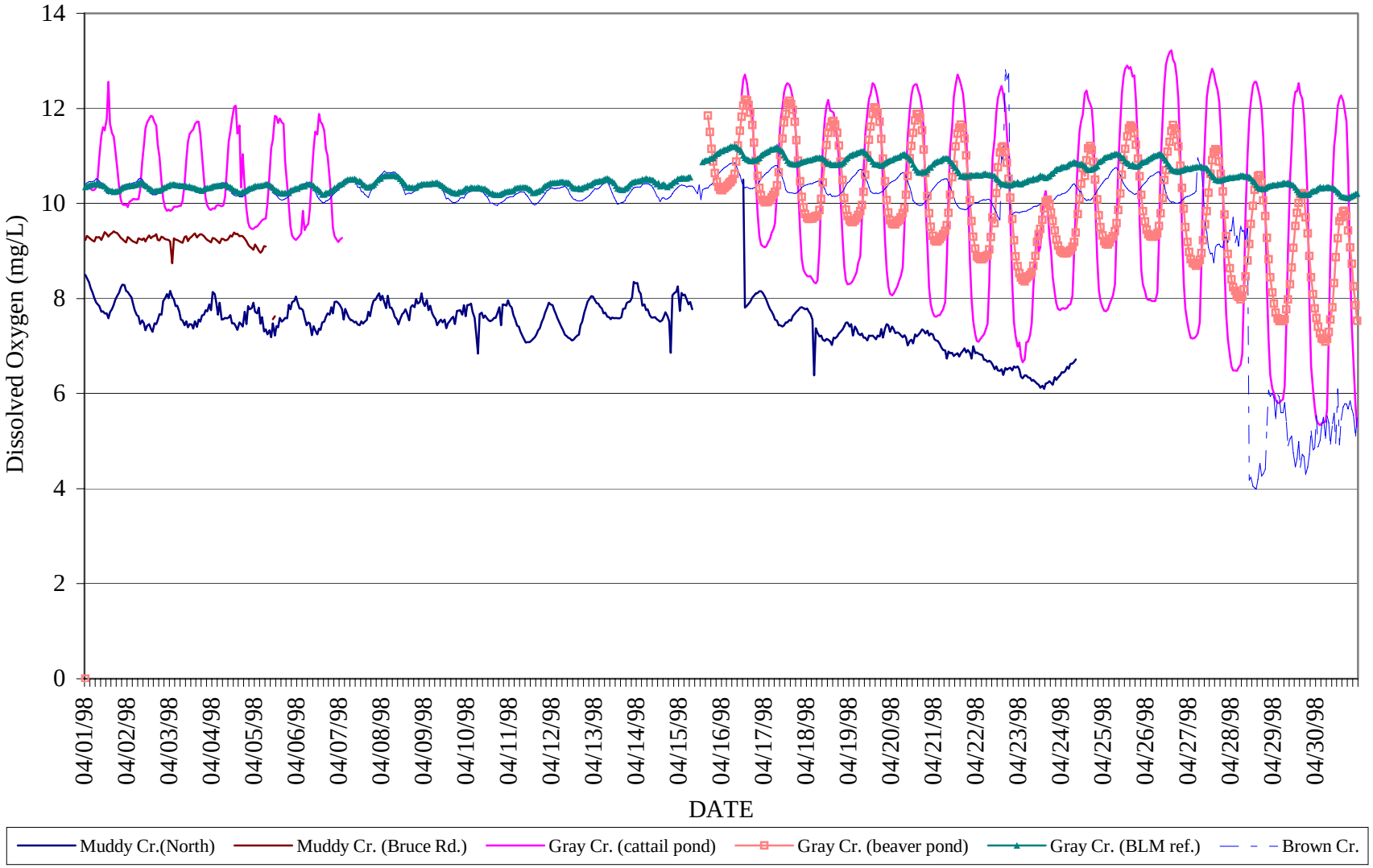

Figure 16. April hydrolab D.O. readings for six sites located in the Finley National Wildlife Refuge, Oregon. Gaps in data are due to battery failures. D.O. measurements from Brown Cr. are suspect.

Conclusions

Temperature, specific conductance, pH and D.O., although variable, appear to fall within normal conditions. Oregon DEQ water quality standards were met at all sites. Because the hydrolab profile at the reference site, Gray Cr. BLM, were similar to all other sites this study was unable to detect adverse effects due to pesticide use.

However, there were differences among sites, most remarkably between Gray Cr. at the cattail pond and Gray Cr. BLM. While Gray Cr. at the cattail pond experienced the greatest daily fluctuation in temperature, pH and D.O, the BLM site had the lowest diel fluctuations. These profile patterns can be attributed to habitat and this is a natural situation. When a waterbody is slow moving and open to solar heating and contains more algae and macrophytes greater temperature, pH and D.O. fluctuations are expected to occur. Likewise, in a situation where water is flowing and the stream is well shaded fluctuations are not as dramatic. This type of variable situation in a study can be avoided by picking a reference site that is more typical of the study sites.

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