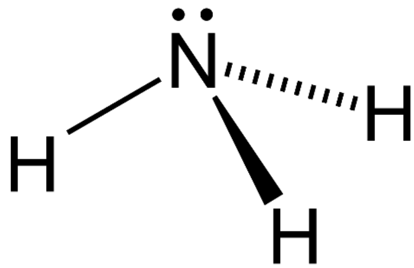
Montana Department of Environmental Quality

Ammonia Assessment Method



Public Comment Draft
July 2024

WQDWQPBWQA-04, Version 1.0

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ACKNOWLEDGEMENTS

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REVISION HISTORY

Revision No.	Date	Modified By	Sections Modified	Description of Changes

SUGGESTED CITATION

Montana Department of Environmental Quality (DEQ). 2024. Ammonia Assessment Method. Helena, MT: Montana Department of Environmental Quality. Document WQDWQPBWQA-04.

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ACRONYMS

ARM	Administrative Rules of Montana
CALM	Consolidated Assessment Listing Method
CCC	Criterion Continuous Concentration
CMC	Criterion Maximum Concentration
CWAIC	Clean Water Act Information Center
DEQ	Montana Department of Environmental Quality
DO	dissolved oxygen
DQA	data quality assessment
EQuIS	MT-eWQX Enterprise database
H_2SO_4	sulfuric acid
HDPE	high-density polyethylene
µg/L	micrograms per liter
mg/L	milligrams per liter
mL	milliliter
MCA	Montana Code Annotated
N	nitrogen
NH_3	ammonia
NH_4	ammonium
NH_3-N+NH_4-N	total ammonia as nitrogen
QA	quality assurance
QC	quality control
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
SAP	sampling and analysis plan
SOPs	standard operating procedures
TMDL	total maximum daily load
WARD	Water Quality Assessment and Reporting Documentation System

1.0 INTRODUCTION

This document details the Montana Department of Environmental Quality (DEQ) ammonia assessment method for all state surface waters with aquatic life use. The Beneficial Use Assessment for Montana's Surface Waters describes the overall process to conduct a beneficial use assessment for a waterbody (Makarowski 2020). This assessment method is not a state rule or regulation.

1.1 BACKGROUND INFORMATION

Ammonia is the concentration of nitrogen (N) expressed as NH_3 and is one of the many forms of nitrogen found in water bodies. Unlike other forms of nitrogen, ammonia can be toxic to aquatic life. The toxicity of ammonia depends on the waterbody's pH and temperature; therefore, ammonia criteria fluctuate depending on these influencing conditions (EPA 1986). As water temperature and pH increase, ammonia toxicity increases.

Ammonia concentration in surface waters tends to be lower during summer than during winter. This is due to the higher rate of plant uptake in the summer and decreased ammonia solubility at higher water temperatures (Maryland Department of Natural Resources 2003). Yet, ammonia is more toxic during the summertime when aquatic plants can drive pH higher and water temperature is generally higher.

Ammonia is naturally found in surface water from decaying organic matter and can be found in water systems with fine silt substrates where there is decomposition of organic matter. Ammonia is also naturally produced from animal waste. While these natural sources are typically very low, it is possible that in the right conditions they can produce harmful concentrations of ammonia nitrogen.

Ammonia can be introduced into surface water in different ways but is usually associated with nitrogen rich concentrated organic or industrial waste in which dissolved oxygen is severely depleted. It can directly enter surface water through municipal effluent discharges or animal feeding operations. It can also enter the water system indirectly though runoff of agricultural lands, nitrogen fixation, and air deposition. Other sources of contamination that can eventually reach surface water are septic seepages or landfill leachate that may enter groundwater. Ammonia is easily treated by introducing oxygen, thus driving nitrogen into more oxidized states such as nitrites and nitrates which are not directly toxic to aquatic life at concentrations found in Montana's surface waters. Generally, ammonia is not prevalent above water quality standards in surface water across Montana, but specific sources may warrant monitoring.

2.0 MONTANA AMMONIA WATER QUALITY STANDARDS

Montana's ammonia water quality standards are contained in the Administrative Rules of Montana (ARM 17.30.621 through 17.30.629) which generally point to footnote seven of Circular DEQ-7 for application of ammonia standards (DEQ 2019). Ammonia standards apply to the aquatic life beneficial use. These ammonia water quality standards vary based on the presence of salmonids, temperature, and pH concentrations. Montana's beneficial use classifications will be used for determining if the salmonid analysis is applied (ARM 17.30.607-613). It is assumed that all waters classified as A-1, B-1, C-1, B-2 and C2 support salmonid growth and propagation. The ammonia standards apply both an acute

(Criterion Maximum Concentration, or CMC) and a chronic criterion (Criterion Continuous Concentration or CCC).

The acute criteria are not to exceed a one-hour average concentration. More stringent acute standards apply when salmonid fish are present than when they are not.

Where salmonid fish are present:

$$CMC = \frac{0.275}{1 + 10^{7.204 - pH}} + \frac{39.0}{1 + 10^{pH - 7.204}}$$

Or where salmonid fish are not present:

$$CMC = \frac{0.411}{1 + 10^{7.204 - pH}} + \frac{58.4}{1 + 10^{pH - 7.204}}$$

The chronic criterion is not to exceed a calculated 30-day average condition and is tailored to protect early life stages of fish when they are present (**Appendix A**). Because of the temporal variability of the early life stages for different salmonid fish species found in cold-water or marginal cold-water streams in Montana, the early life stage standards should be applied year-round for these waters. Warm-water fisheries early life stages are applied from March 15th through August 31st. In addition, the highest four-day average within the 30-day period should not exceed 2.5 times the chronic criterion.

When fish early life stages[1] are present:

$$CCC = \left(\frac{0.0577}{1 + 10^{7.688 - pH}} + \frac{2.487}{1 + 10^{pH - 7.688}} \right) \times MIN\left(2.85,\ 1.45 \times 10^{0.028 \times (25 - T)}\right)$$

When fish early life stages[1] are absent:

$$CCC = \left(\frac{0.0577}{1 + 10^{7.688 - pH}} + \frac{2.487}{1 + 10^{pH - 7.688}} \right) \times 1.45 \times 10^{0.028 \times (25 - MAX(T,7))}$$

[1] Includes all embryonic and larval stages and all juvenile forms of fish to 30-days following hatching.

Because these formulas are non-linear in pH and temperature, the standard must be calculated by the average of separate evaluations of the formulas reflective of the fluctuations of pH and temperature within the averaging period. It is not appropriate to apply the formula to average pH and temperature.

For Class A-Closed, ARM 17.30.621(3)(h) does not reference DEQ-7 and instead says no increases of toxic parameters above naturally occurring concentrations, are allowed. A-closed waters will be assessed if water quality modeling, or upstream/downstream monitoring indicate anthropogenic sources increase ammonia concentrations.

3.0 Exceedance Frequency Analysis and Justification

Montana's standards incorporate an exceedance frequency component that indicates no more than one exceedance within three years. The difficulty with this approach is that standards attainment decisions based on this rate do not take into consideration the number of sampling results or the variability of sampling frequencies. Using a one in three-year exceedance rate for standards attainment decisions may create a large variance in exceedance rates depending on the size of the data set. As the data set increases over a three-year period, the allowable exceedance rate is reduced and the potential for attainment decision errors changes.

- For example: Annual sampling, or three samples over three years, allowable exceedance rate = 33.3%
- Semi-annual sampling, or six samples over three years, allowable exceedance rate = 16.6%
- Quarterly sampling, or twelve samples over three years, allowable exceedance rate = 8.3%
- Monthly sampling, or 36 samples over three years, allowable exceedance rate = 2.8%

In these four scenarios, the two extremes (annual sampling and monthly sampling) are not realistic due to a lack of confidence (just having 3 samples) or due to the cost (36 samples). The sampling scenarios of semi-annual and quarterly sampling are most representative of the size of typical data sets. DEQ therefore determined that an exceedance rate of 10% is adequate. This is consistent with multiple other states that have set their exceedance rate at 10% (e.g., California Environmental Protection Agency State Water Resources Control Board 2004). In cases where more certainty is needed, larger data set collection should be planned.

In addition to the 10% exceedance rule, a no more than one exceedance in a three-year timeframe provided in DEQ Circular 7 will also be applied. If either of these tests fails, the decision will be to list ammonia as a pollutant impairing aquatic life, or keep it listed. If both tests pass, the decision will be to delist or not list ammonia. If either or both tests fail, the decision will be to list ammonia as a pollutant that affects aquatic life. Both the 10% and more than one in three-year exceedance rates will be applied to the acute and 2.5x the chronic criteria. Only the more than one in three-year exceedance rate will be applied to the chronic criteria. See Section 6.2 for more detail and context.

4.0 Sampling and Data Quality Considerations for Ammonia Assessment

Waterbody condition must be evaluated based on all existing and readily available data and information (§75-5-702, MCA; 40 CFR 130.7(b)(5)). This section describes several considerations for developing monitoring designs and assessing data quality when performing ammonia assessments.

4.1 Data Currency

Data collected within the past ten years are considered current and may be used in making assessment decisions (Makarowski 2020). If during this period significant changes in sources have been documented, the assessor may use best professional judgment when determining which data are appropriate to include in the assessment. The assessor should document the specific changes, identify data currency alternatives, and determine which years of data are appropriate to include in the assessment process.

4.2 Sample Collection, Analysis, and Units

Samples are collected on site in 250 mL high density polyethylene (HDPE) vessels then are to be preserved as soon as possible with sulfuric acid (H_2SO_4). Then the samples are to be stored at <6°C or frozen until delivery to the lab for analysis. The samples have a hold time of 28 days. Alternatively, samples may be immediately cooled until frozen on the day of the sampling without using a preservation additive. If frozen, the holding time is extended to 45 days. Ammonia samples are typically analyzed according to EPA 350.1, which is referred to as the Phenate method. The Quality Assurance Project Plan for Water Quality Planning Bureau Environmental Data Operations states the required reporting limits (DEQ 2022). The process uses steam distillation to isolate the ammonia, followed by a colorimetric chemical reaction. The concentration of ammonia is found through spectrophotometry or through Ion Selective Electrode (EPA 1993). Ammonia is best recorded in micrograms per liter (µg/L) since the water quality standard for ammonia is also provided in µg/L.

Ambient water temperature and pH must be measured at the same time as ammonia is measured (within an hour) to accurately calculate ammonia standards. Temperature should be measured in or converted to Celsius for the calculation of standards. See DEQ handheld and *in situ* water quality meter standard operation procedures (SOPs) for further guidance concerning temperature and pH measurements.

Montana's definition of ammonia to be compared to criteria is total ammonia. For new data collection, the preferred method is to analyze total ammonia as nitrogen (EPA 350.1). When evaluating existing data, care must be taken to ensure the correct form of ammonia is being reported and compared. Where total recoverable ammonia as N data is available, it may be compared directly to the standard during assessment if generated by a comparable analytical method to EPA 350.1. Dissolved ammonia may be evaluated against the standard but should only be used if the datum represents an exceedance. If only dissolved ammonia is available and it is less than the standard, there may be insufficient data to complete the assessment.

4.3 Sampling Timeframe and Temporal Independence

Ammonia samples can be collected throughout the year, but prioritization should focus on the time of year that toxicity levels are higher or when sources are the most prevalent (**Section 1.1**). Spawning and rearing timeframes should be considered for warm water classifications. When scheduling sampling for the purpose of this method, samples should fully target spawning and rearing timeframes. For a delisting on a warm water stream, minimum data requirements must be fully met within the spawning and rearing timeframe.

During high flow, the temporal independence will be evaluated on a case-by-case basis due to the changing discharge conditions. During baseflow there should be a seven-day period between sampling events.

4.4 Sampling Locations and Spatial Independence

Guidance for selecting sampling locations is intended to help ensure spatial independence of data.

4.4.1 Assessment Unit Selection

Ammonia assessment decisions are made by individual assessment unit. An assessment unit may be an entire waterbody or segment of a waterbody (e.g., headwaters to a tributary). DEQ or other entities may prioritize monitoring of waters that have been previously identified as impaired or waters at higher risk of ammonia impairment due to human activities, point sources, agricultural use, or other factors. All readily available data must be included for assessment for any unit that is part of a 303(d)-assessment project.

4.4.2 Assessment Reaches

The assessment analysis may take place over the entire assessment unit or over an assessment reach. An assessment reach is when the assessment unit is sub-segmented, which may be justified if one or more significant shifts in type and intensity of potential ammonia sources and sinks exist such that clear breaks could be made to designate homogenous sub-reaches (Suplee and Sada 2016). For example, if a relatively unimpacted upstream reach can be isolated and its condition is substantially different from other downstream parts of the assessment unit, the assessment unit may be split into two sub-reaches for assessment purposes. The following guidelines should be used when sub-segmenting an assessment unit:

- If one reach indicates impairment, the entire assessment unit receives the impairment determination.
- Each reach has the same general data requirements (e.g., dataset minimums) as the parent assessment unit would have had if it hadn't been divided.
- It is better to lump than to split reaches to avoid excessive sub-segmentation and the consequential administrative and sampling requirements that result.
- An assessor must decide whether to sample potential reach breaks in an assessment unit before data collection; this will help ensure that reach breaks are based on considerations of land use and sources.

4.4.3 Total Number of Sites and Site Locations

This section provides guidance for developing monitoring plans for ammonia assessments; however, all readily available data must be used at the time of assessment. This section also provides guidance to determine if enough data is available for final beneficial use assessment.

For ammonia, assessment determinations are made using data pooled for the entire assessment unit or reach, not individual sites. Best professional judgement may be applied to determine how many sites are needed to adequately represent the range of potential human sources influencing the assessment unit. It is preferable to incorporate data collected at multiple sites to better capture variability in ammonia concentrations throughout the assessment unit. If only one site is planned for monitoring, it must be located at the most at-risk location after evaluation of potential sources. Sites may also bracket sources to aid in locating sources (e.g., agricultural runoff, wastewater treatment outfalls, and dams). The number and locations of sites should represent the entire assessment unit or reach.

4.4.4 Spatial Independence

Sites should be spatially independent of each other. Spatial independence relies on best professional judgment, particularly when combining data from multiple sources and projects. The following guidance for achieving spatial independence for ammonia testing is similar to other pollutant specific assessment methods (Drygas 2012; Suplee and Sada 2016):

- Select sites that are at least one stream mile apart unless there is a flowing tributary that confluences with the segment, or a discrete source is located between the two sites.
- Monitor below areas where tributaries or ditches mix with the assessment unit.
- Consider land use to help identify potential impacts on ammonia concentrations.

4.5 Sample Size

Acute and chronic standards assessments are completed independently. Both criteria do not have to be evaluated to produce an impaired assessment outcome. Both criteria must be evaluated to produce a delisting. A sample is defined as temporally paired ammonia, pH, and temperature data at a spatially independent site and date.

4.5.1 Acute Criteria

A minimum of eight independent samples is needed for an assessment unit or reach to assess acute criteria. More rigorous data collection may be unnecessary if there are already a minimum of three exceedances of acute aquatic life standards in data sets of three to seven samples spread over 10 years. If 2 samples within a 3-year timeframe are exceeded, the assessor should continue to list ammonia. In these situations where minimum data is not attained but there is a large exceedance rate, the attainment decision will be to list or to remain listed and a data quality assessment override in the WARD database can be justified. A sample size of at least 11 samples is necessary if point sources are present or for a delisting.

4.5.2 Chronic Criteria

At least three samples within any 30-day period, spaced at least six days apart, are needed to calculate if the chronic 30-day criteria are achieved. At least two 30-day periods during any growing season are needed to evaluate the chronic criteria. For de-listings, at least two years must be represented by a chronic criteria evaluation. Average monthly calculations are used to evaluate the 30-day average. The chronic criteria do not need to be evaluated to apply an acute analysis. If acute or chronic minimum data requirements are met, any sample may represent a four-day average to compare to the 2.5x higher than the chronic criteria.

5.0 Data Quality

This assessment method is subject to DEQ Water Quality Division's established policies and procedures for quality assurance and quality control, beneficial use assessment, and data management. Data quality requirements apply to all data used for making assessment decisions, whether collected internally or externally. DEQ will require that QA systems are applied to data that are used during 303(d) assessments. Sampling plans or a DEQ approved equivalent are required (Makarowski 2020).

5.1 Quality Control: Field Duplicates and Field Blanks

Field duplicates are samples collected as close as possible to the time and location where the original sample was collected at the site. They should be collected by the same person using the same collection method outlined in the sampling and analysis plan, but they are stored in separate bottles and analyzed independently. Any ammonia sampling design intended for assessing water quality standards should incorporate field duplicates. Additionally, the frequency of duplicate sampling should be documented in a quality assurance project plan (QAPP) or sampling and analysis plan (SAP). Typically, field duplicates are collected at a minimum frequency of 10% of total samples.

Selection of timing and sites for field blank collection is generally up to the judgement of the project manager but should include significant storage time in the sample cooler to represent the handling process. Field blanks should <u>not</u> occur at the last site or day of a longer trip, so they also experience transportation and field storage management practices that other samples are exposed to. Field blanks are samples collected and handled following the same methods as routine samples except laboratory-grade deionized or distilled water is used rather than ambient water. Field blanks represent total ambient conditions during sampling and laboratory processing to identify possible sources of contamination (EPA 2009). Any ammonia sampling design intended for assessing water quality standards should incorporate field blanks and the frequency should be documented in a QAPP or SAP. Typically, at least one field blank is analyzed along with each batch of routine samples.

5.2 Data Quality Assessment Overview

Data quality assessment (DQA) is the scientific and statistical evaluation of data to determine whether data obtained from monitoring operations are of the right type, quality, and quantity to support water quality assessments (EPA 2002a). Assessors use DEQ's Water Quality Assessment and Reporting Documentation (WARD) System to document the DQA outcome (pass or fail) for each parameter group being assessed per beneficial use. All data quality indicators must be met to pass the DQA. If a single indicator is not met, the DQA fails for that parameter group. An assessor may override a pass or fail for the DQA, but they must accompany this override with adequate justification. In these cases, a manager or QA officer would need to approve the override.

Additional data quality screening may be necessary before the dataset is ready to support attainment decisions (EPA 2000, EPA 2002b), for example:

- Ensuring detection levels are sufficiently low to support project decision making: Non-detects are used in the data analysis and the value of the detection can be used for statistical methods if it is below the standard. Non-detects above the standard should be excluded from analysis.
- Evaluating database flags and justification and documentation of non-used data.
- Evaluating QC samples (i.e., field duplicates and field blanks)
- Verifying that holding time and incubation times were adhered to
- Reviewing QA/QC reports
- Investigating errors in collection or analysis
- Addressing missing data
- Reviewing deviations from SOPs and SAPs

Once DEQ determines the data meets basic documentation requirements, the data are ready to be analyzed to support water quality standards attainment decisions.

6.0 Data Analysis for Water Quality Standards Attainment Decisions

Total ammonia as nitrogen concentration (µg/L) is the only data type that is to be applied directly to the Montana ammonia water quality standards. Dissolved ammonia as nitrogen may be reviewed to see if concentrations are above the total recoverable standard but can't be used to determine if standards are met. Temperature and pH measurements at the same site and time are needed to calculate ammonia standards. A sample is defined as all three measures collected at the same site and time, within an hour's timeframe.

6.1 Overview of the Assessment Decision Framework

The same process and decision framework will be applied whether the data are collected during early life stages or other life stages in warm-water, cold-water, or marginal cold-water streams. For each assessment unit the data will be compiled and evaluated for quality. Results will be compared to the appropriate ammonia water quality standards (**Section 2.0**).

6.2 Assessment Process

The water quality standards are provided in **Section 2.0**. Due to the extensive variability of the early life stages for fish found in cold-water or marginal cold-water streams in Montana, the early life stages should be applied year-round for these assessment units. Warm-water streams early life stages are applied from March 15th through August 31st.

1. Compile all the ammonia data for an assessment unit or assessment reach (**Section 3.4**).
2. Perform data quality assessment to identify the usable dataset (**Section 5.0**).
3. Group data by site and calculate all appropriate exceedances. Determine if sites have higher exceedance rates than others, review potential sources, and determine if reach breaks may be needed.
4. Organize data for the evaluation unit by year and aggregate dependent data according to **Sections 3.3 and 3.4.4**.
    a. Acute Criteria
        i. Compare each sample to the sample's calculated standard. Use the appropriate acute standard based on presence of salmonids. Do not use ammonia results if there is no associated temperature and pH data.
        ii. An impairment listing for ammonia would commence if more than 10% of samples exceed the standard over 10 years <u>or</u> more than one sample within any 3-year period exceeds the standard. No acute standard based ammonia listing is warranted if both tests pass.
        iii. Proceed to Chronic Criteria.
    b. Chronic Criteria
        i. Group result values by month to interpret the 30-day periods during which they were collected.
        ii. Calculate the average condition and average chronic criteria for all non-overlapping timeframes when three or more samples were collected within each month's timeframe. Ensure use of the correct chronic criterion based on likely presence of early life stages **(Appendix A).** Compare existing conditions against the average of the standard calculations for the monthly samples. Do not pool temperature and pH conditions to calculate the monthly chronic standard. Average after the individual calculations.
        iii. If more than one monthly average in any three-year timeframe is exceeded, then the assessment would determine an impairment for ammonia based on chronic criteria. Proceed to the next step.
        iv. Evaluate all individual samples (from the acute criteria evaluation) against 2.5x the individual sample chronic criterion.
        v. If more than 10% of samples exceed 2.5x chronic standard <u>or</u> more than one sample within any three-year period exceeds 2.5x chronic standard, then the

assessment would determine an impairment for ammonia based on chronic criteria.

vi. No chronic criteria-based ammonia listing is warranted if all tests chronic tests pass.

vii. A chronic criteria-based ammonia listing is warranted if any of the tests fail.

c. Beneficial Use Assessment for Ammonia

i. If all chronic and acute tests pass, ammonia supports the aquatic life beneficial use and ammonia is not identified as an impairment cause.

ii. If only the acute analysis can be completed and passes, ammonia is not identified as an impairment cause.

iii. If any chronic or acute tests fail, ammonia is identified as a cause of impairment to aquatic life use.

iv. Both acute and chronic tests are necessary and must pass for a delisting.

6.3 Source Assessment and Supplemental Information

Probable sources of impairment are the activities, facilities, or conditions that generate the pollutants that prevent waters from meeting water quality standards. The following sources are the most likely to be associated with ammonia impairment listings in Montana; additional selections are available in the Water Quality Assessment and Reporting Documentation (WARD) system if needed:

- Impoundments
- Municipal Waste Treatment Outfalls
- Septic Sewage
- Industrial Point Sources
- Agricultural and Urban Runoff
- Manure Application
- Animal Feeding Operations
- Landfill Leachate
- Atmospheric Sources
- Riparian vegetation loss
- Natural sources

If water quality data are available that prove, or a TMDL identifies, a probable source is contributing ammonia, the assessor should check the Source Confirmed box in WARD. If probable sources are present in the watershed but are not confirmed, the assessor should check the Source Not Confirmed box. The assessor may also include a brief description of sources in the overall condition of the waterbody summary in WARD.

6.4 Reporting Assessment Decisions and Review with Management

The assessor must document all data and decisions made pertaining to beneficial use support determinations for assessment units. Assessment outcomes for individual assessment units, including data summaries, impairment determinations and beneficial use support determinations are documented via Montana DEQ’s Clean Water Act Information Center (CWAIC) (available at www.cwaic.mt.gov). Waterbodies identified as impaired due to ammonia are included in Montana’s biennial Water Quality Integrated Report and list of impaired waters. Assessment decisions are reviewed by the Monitoring and Assessment Section Supervisor and may be reviewed by the QA Officer, managers, or staff from other DEQ programs.

7.0 Public Information

Ammonia data collected by DEQ is stored in DEQ's MT-eWQX Enterprise (EQuIS) database and is uploaded weekly to the Water Quality Portal (EPA, USGS, NWQMC, 2023). Assessment outcomes for individual assessment units, including data summaries, impairment determinations, and beneficial use support determinations, are documented via Montana DEQ's CWAIC (available at www.cwaic.mt.gov).

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APPENDIX A: TABLE OF SPAWNING TIMES OF MONTANA FISHES

SPAWNING TIMES OF MONTANA FISHES, Prepared by Don Skaar, Montana Fish, Wildlife and Parks, 3/6/01. This table is a combination of known spawning times for fish in Montana and estimates based on spawning times reported in other areas in North America of similar latitude. Sources used for this table include: G.C. Becker, Fishes of Wisconsin; C.J.D. Brown, Fishes of Montana; K.D. Carlander, Handbook of freshwater fishery biology, volumes 1 and 2; R.S. Wydoski, and R.R. Whitney. Inland fishes of Washington; Scott and Crossman. Freshwater fishes of Canada; Montana Fish, Wildlife and Parks fisheries biologists.

The code for the table is as follows: J1, J2, F1, F2 refer to the half month increments of January 1-15, January 16-31, February 1-14, February 15-29, and so on. In the table S = spawning period, I = incubation period for eggs of salmonids, E = time period in which salmonid sac-fry are in the gravels

Species	J1	J2	F1	F2	M1	M2	A1	A2	M1	M2	J1	J2	J1	J2	A1	A2	S1	S2	O1	O2	N1	N2	D1	D2
White sturgeon									S	S	S	S												
Pallid sturgeon										S	S	S	S	S										
Shovel. sturgeon										S	S	S	S	S										
Paddlefish									S	S	S	S	S	S										
Goldeye						S	S	S	S	S	S													
Cisco	I	I	I	I	I	I															S	S	S	S
Lake whitefish	I	I	I	I	I	I													S	S	S	S	S	S
Mount. whitefish	I	I	I	I	I	I												S	S	S	S	S	I	I
Pygmy whitefish																					S	S	S	S
Kokanee	I	I	I	I	I													S	S	S	S	S	I	I
Chinook salmon																			S	S				
Golden trout											S	S	S	S	I	I,E								
Cutthroat trout							S	S	S	S	S	S	S	I	I	E								
Rainbow trout					S	S	S	S	S	S	S	S	I	I	E									
Brook trout	I	I	I	I	E	E	E	E	E								S	S	S	S	I	I	I	I
Bull trout	E	E	E	E	E	E	E	E	E							S	S	S	S	S	I	I	I	I
Lake trout	I	I	I	I	I	I	I	I											S	S	S	S	S	I
Brown trout	S	I	I	I	I	I	I	I,E										S	S	S	S	S	S	S

Species	**J1**	**J2**	**F1**	**F2**	**M1**	**M2**	**A1**	**A2**	**M1**	**M2**	**J1**	**J2**	**J1**	**J2**	**A1**	**A2**	**S1**	**S2**	**O1**	**O2**	**N1**	**N2**	**D1**	**D2**
A. grayling								S	S	S	S	S	S,I											
Redband trout												S	S	I										
Northern pike					S	S	S	S	S															
Carp									S	S	S	S	S	S	S	S								
Golden shiner									S	S	S	S	S	S										
Pearl dace																								
Creek chub						S	S	S	S	S	S	S												
N. redbelly dace									S	S	S	S	S	S										
Finescale dace							S	S	S	S														
Utah chub									S	S	S	S	S	S										
Flathead chub									S	S	S	S	S	S	S									
Sturgeon chub										S	S	S	S	S	S									
Lake chub										S	S													
Sicklefin chub											S	S	S	S	S	S								
Peamouth									S	S	S	S												
Emerald shiner													S	S	S	S								
Spottail shiner											S	S	S	S	S	S								
Sand shiner									S	S	S	S	S	S	S	S								
Brassy minnow									S	S	S	S												
Plains minnow							S	S	S	S	S	S	S	S	S									
WSilveryminnow									S	S	S	S	S	S										
Fathead minnow									S	S	S	S	S	S	S	S								
N. Pike minnow									S	S	S	S	S											
Longnose dace									S	S	S	S	S	S	S									
Redside shiner										S	S	S	S	S	S									
River carpsucker									S	S	S	S												
Blue sucker							S	S	S	S	S													
Small. Buffalo									S	S	S													
Big. Buffalo									S	S	S	S	S											

Species	J1	J2	F1	F2	M1	M2	A1	A2	M1	M2	J1	J2	J1	J2	A1	A2	S1	S2	O1	O2	N1	N2	D1	D2
Short. Redhorse							S	S	S	S	S	S												
Longnose sucker						S	S	S	S	S	S	S	S											
White sucker							S	S	S	S	S	S												
Largesc. Sucker							S	S	S	S														
Mountain sucker											S	S	S	S										
Black bullhead									S	S	S	S	S											
Yellow bullhead									S	S	S	S	S											
Channel catfish									S	S	S	S	S											
Stonecat											S	S	S	S	S	S								
Burbot			S	S	S	S																		
Brook stickleback									S	S	S	S												
Rock bass									S	S	S	S												
Green sunfish									S	S	S	S	S											
Pumpkinseed										S	S													
Bluegill									S	S	S	S	S											
Smallmouth bass									S	S	S	S												
Largemouth bass									S	S	S	S	S											
White crappie										S	S	S	S											
Black crappie									S	S	S	S												
Yellow perch						S	S	S	S	S	S	S												
Sauger						S	S	S	S	S														
Walleye							S	S	S	S														
Iowa darter									S	S	S	S	S											
Mottled sculpin									S	S	S	S												
Slimy sculpin																								
Torrent sculpin																								
Shorthead sculpin																								

Species	**J1**	**J2**	**F1**	**F2**	**M1**	**M2**	**A1**	**A2**	**M1**	**M2**	**J1**	**J2**	**J1**	**J2**	**A1**	**A2**	**S1**	**S2**	**O1**	**O2**	**N1**	**N2**	**D1**	**D2**
Spoonhead sculpin																								