

Database Design Project:  
Boreal Toad Survey Database  
Melissa Gfeller  
GEOG 6150  
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## **Introduction:**

The idea for my database came from my time volunteering at the Utah's Hogle Zoo. As a volunteer I have participated in many Boreal Toad surveys. The Utah Department of National Resources (DNR) uses the information from our surveys to help track the Boreal toad populations throughout Utah. These surveys done by both the DNR and Volunteers are very important because there are 114 survey sites for boreal toads in Utah. If the DNR had a geospatial database for their data they would be able to expand their analysis of Boreal Toad population health. This is a very important task because boreal toad populations as well as other amphibians are being killed by chytrid fungus. The chytrid fungus is deadly because it coats an amphibian's skin. The direct cause of death is unknown but given that amphibians drink and breathe through their skin this could make both those tasks difficult. High altitude species like the boreal toad are particularly vulnerable. This is partly because the conditions required for survival are very specific. Boreal toads need to live above 5000 feet and live near marshy wetlands or lake regions. The need for a boreal toad database is very critical to receive the most current data for boreal toad health.

## **Integrity Constraints:**

Boreal Toad data is an entity type. Boreal Toad Data is related to DWR Region and Field Site. Boreal Toad Survey Data has Attributes: "ToadID", "Day", "Month", "Month\_T", "Year", "Life\_Stage", "SiteName", "Tagged", "Gender" and "Region".

Field Site(polygon) is related to Lake Region, Trail, Field Site(point), Boreal Toad data and DWR region. Field Site(polygon) has Attributes: "FieldName", "Toads", "Year", "TrailName", "RegionID", "Site\_ID", "GNIS\_ID", "GNIS\_Name", "Area", "Length" and "BUFF\_DIST". Lake Region has Attributes: "GNIS\_ID", "GNIS\_Name", "Area", "Length", "FCode\_Text" and "Elevation". Trails has Attributes: "SystemName", "PrimaryNam", "HikeDiffic", "TrailID", "Designated", and "RegionID". Field Site(point) has Attributes: "GNIS\_ID", "GNIS\_Name", "Elevation" and "Elevation\_FT".

DWR Region is also related to DNR Station and Chytrid Region. DWR Region has Attributes: "DWR\_Region", "Region\_Office", "Region\_ID", "Area", "Length", and "STATE". DNR station locations has Attributes: "Office\_Name", "Address", "Lat", "Long", "Phone\_Number", "Region" and "Office\_Type". Chytrid Region has Attributes: "ID", "Population", "Chytrid", "Region", "Year", "Lat" and "Long".

Conservation Location is related to Toad Relocation Sites. Toad Conservation Locations has Attributes: "ID", "Name", "City", "State", "Phone Number", "Address", "Type", "Lat", and "Long". Toad Relocation Site has Attributes: "ReLoc\_ID", "City", "State", "Lat", "Long" and "FromConLoc\_ID".

## **Conceptual Model Description:**

The integrity constraints above identify the majority of the components for the conceptual model. There are however pieces missing that are very important to create the relational model. The cardinality component is extremely important to the development of a functional database. For this database most of the relationships are 1:Many. For example one region to many field

sites. There are a select few that have a 1:1 relationship which are Field Site to Lake Region, Field Site to Field Point, and Conservation Location to Relocation Site. Cardinality is important to create the relationship class which are developed in the next phase.

### **Relational Model Description:**

One of the unique layers I created was the chytrid sites. At first I had expected to relate this layer to Field Site but there was insufficient links. The DNR can only test a few samples every few years. This only provides a small sample size of chytrid locations. The most recent data was from 2014 and only tested 14 of the 114 sites. The test locations were not related to specific sites but to more general locations. This is why this layer cannot be related to Field Sites. Although the chytrid layer did not work for field sites I was able to link it to DWR Regions. Given the general locations of the chytrid test sites this made for a better relationship class.

Another unique connection is the Conservation Location and Relocation Site. Conservation Location was going supposed to be linked to Boreal Toad Data but after further reflection this did not make sense. The Boreal Toad Data is only toads from Field Sites while the toads from the Conservation Location are breed in captivity. This is why I chose to only relate Conservation Locations to Relocation Sites.

I had intended the DEM to be related to multiple fields but this cannot be done with a raster the way I planned. I did use the layer to fill in my elevation values but that was from manual inputs not from a join. The inability to join or relate this layer left it as the only unrelated layer in the database.

### **Physical Model Description:**

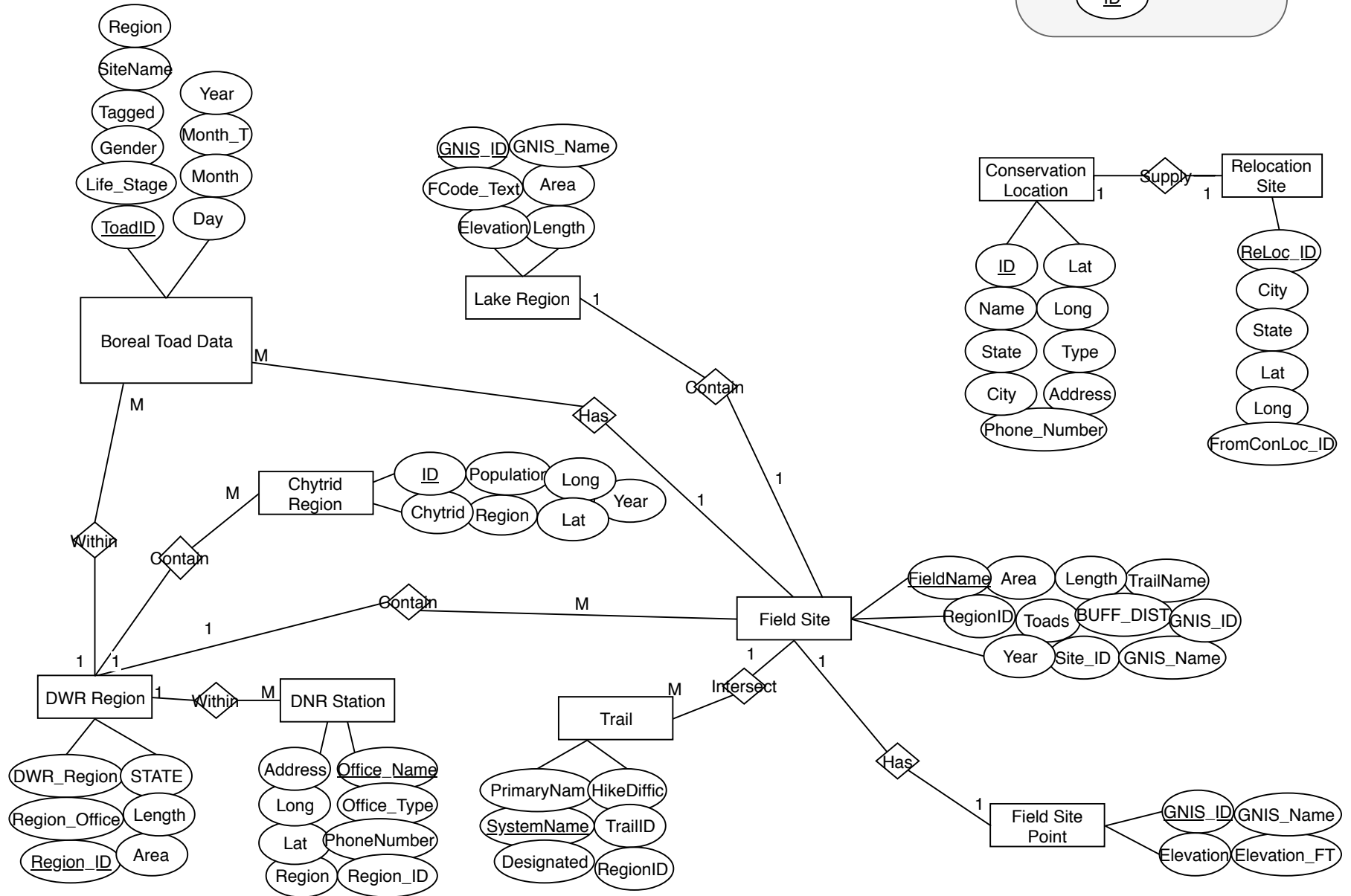
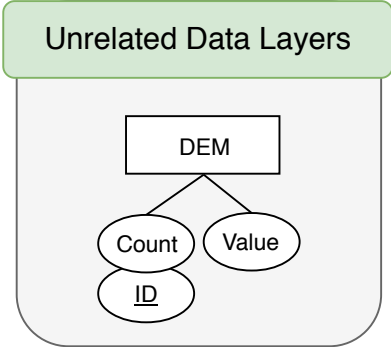
The relational model creates a good transition to the physical model. The relational model describes the various connections that will be established when the database is created. For this database there are 9 different relationship classes: Conservation Locations and Relocation Sites, DWR Regions and Boreal Toad data, DWR Regions and Chytrid Sites, DWR Regions and DNR Stations, DWR Regions and Field Sites, Field Sites and Boreal Toad data, Field Sites and Lakes Partial, Field Sites and Trails Partial, and Field Sites and Field Site points. Given these relationship classes a user can choose a year and a field site and discover if toads were found at that field site for that chosen year. By choosing a DWR region the user could determine if there were positive chytrid fungus test sites. These types of queries are important to determine the health of the various field sites and the boreal toads that inhabit them. If a field site is queried and there has been no toads found multiple years in a row then that indicates a possible decline in the boreal toad population at that site.

### **Future Directions:**

In the future I want to expand the scope of the database given the success of the process so far. I would include all 114 survey sites as well as past and present toad data. I could also expand upon the DNR Station layer and include all the field stations for the state of Utah. The most time consuming part would be the survey sites because of the complexity of the lakes layer. To find the exact pond or lake is very challenging because not all the features have names. So

identifying the correct site is a challenge. I plan to add domains to various fields particularly the boreal toad data. Adding domains to gender, tagged and life stage would help simplify the data input process. There are other fields that domains can be added to simplify database. Improvements can be made in the future but the current database is fully functional.

# Melissa Gfeller ER Diagram Final Project



Melissa Gfeller  
Relational Model  
Final Project

DWR Region	
PK	<b>Region_ID (integer)</b>
	DWR_Office (str 150)
	Region Office (str 50)
	STATE (str 150)
	Area (float)
	Length (float)

DNR Station	
PK	<b>Office Name (str 50)</b>
	Office_Type (str 50)
	Address (varchar)
	PhoneNumber (varchar)
	Long (float)
	Lat (float)
	Region (str 50)
FK	Region_ID (integer)

Field Site (polygon)	
PK	<b>FieldName (str 150)</b>
	Site_ID (integer)
	BUFF_DIST (integer)
	Area (float)
	Length (float)
	Toads (str 10)
FK	TrailName (str 150)
	Year (integer)
FK	RegionID (Integer)
	GNIS_Name (str 50)
FK	GNIS_ID (integer)

Lake Region	
PK	<b>GNIS_ID (integer)</b>
	GNIS_Name (str 50)
	Area (float)
	Length (float)
	Elevation (float)
	FCode_Text (varchar)

Chytrid Region	
PK	<b>ID (integer)</b>
	Population (str 50)
	Chytrid (str 50)
	Lat (float)
	Long (float)
	Year (integer)
FK	Region (Integer)

Boreal Toad Data	
PK	<b>ToadID (integer 15)</b>
	Life_Stage (str 150)
	Gender (str 20)
	Tagged (str 10)
	Day (integer)
	Month_T (str 150)
	Month (integer)
	Year (integer)
FK	SiteName (str 150)
FK	Region (integer)

Conservation Location	
PK	<b>ID (integer)</b>
	Name (varchar)
	City (str 50)
	State (str 50)
	Phone_Number (varchar)
	Address (varchar)
	Type (str 50)
	Lat (float)
	Long (float)

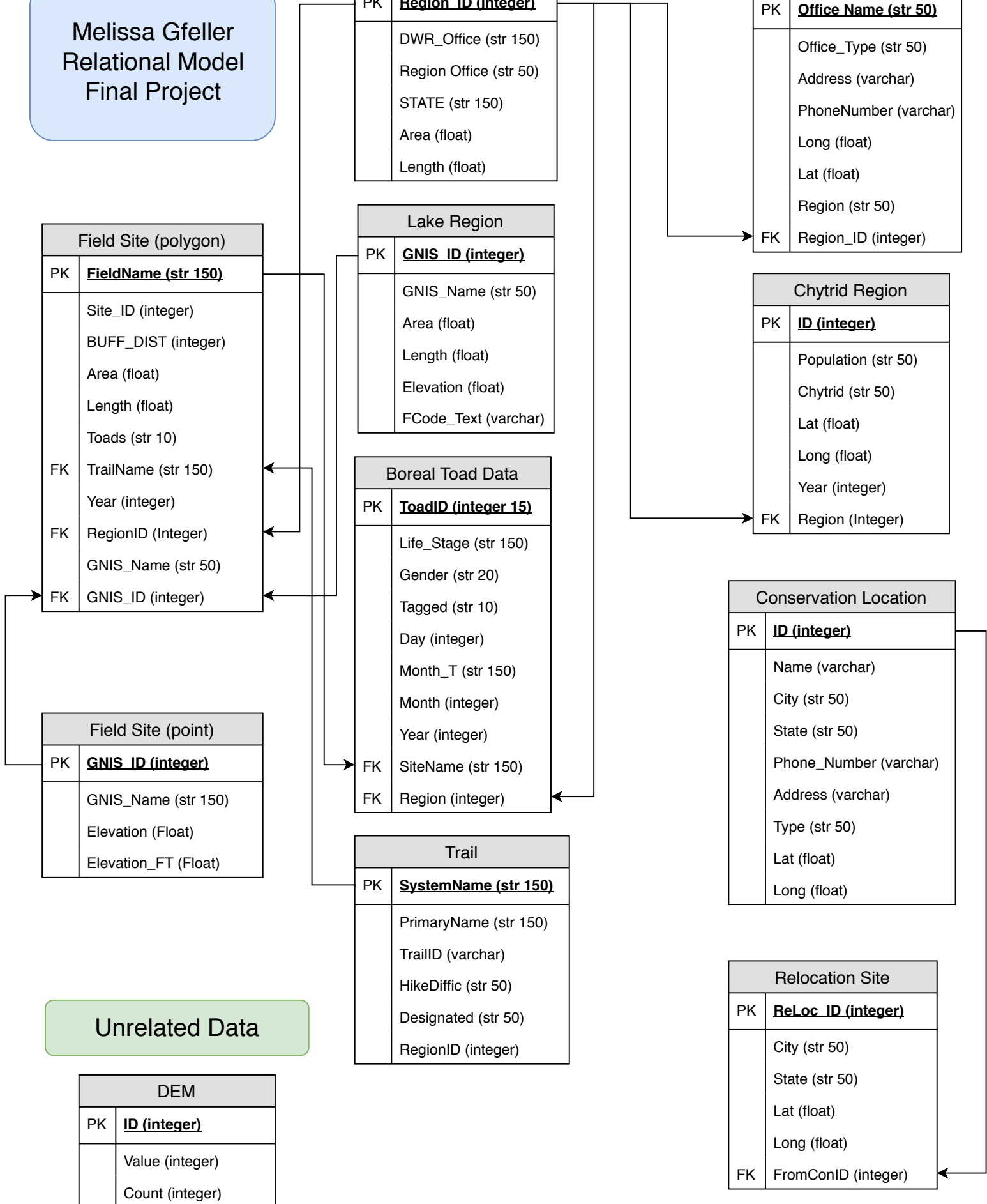
Field Site (point)	
PK	<b>GNIS_ID (integer)</b>
	GNIS_Name (str 150)
	Elevation (Float)
	Elevation_FT (Float)

Trail	
PK	<b>SystemName (str 150)</b>
	PrimaryName (str 150)
	TrailID (varchar)
	HikeDiffic (str 50)
	Designated (str 50)
	RegionID (integer)

Relocation Site	
PK	<b>ReLoc_ID (integer)</b>
	City (str 50)
	State (str 50)
	Lat (float)
	Long (float)
FK	FromConID (integer)

Unrelated Data

DEM	
PK	<b>ID (integer)</b>
	Value (integer)
	Count (integer)



Using the 'Field Site' layer Select "Silver Lake" relates to 'Toad Data'. To find the number of toads found at Silver Lake.

OBJECTID	Shape	Site_ID	FieldName	TrailName	Toads	Year	GNIS_ID	GNIS_Name	SHAPE_Leng	BUFF_DIST	SH
1	Polygon	18	Cecret Lake	Cecret Lake Trail	Y	2017	01445416	Cecret Lake	527.119449	15	
2	Polygon	5	Lake Catherine	Catherine Pass Trail	N	<Null>	01439539	Lake Catherine	451.510467	15	
3	Polygon	72	Lake Martha	Catherine Pass Trail	N	<Null>	01443207	Lake Martha	401.163437	15	
4	Polygon	7	Lake Mary	Lake Mary Trail	Y	2014	01443216	Lake Mary	1810.293672	15	
5	Polygon	116	Lake Florence	Lake Blanche Trail	Y	2018	01428021	Lake Florence	435.29215	15	
6	Polygon	115	Lake Lillian	Lake Blanche Trail	Y	2017	01429613	Lake Lillian	829.233347	15	
7	Polygon	9	Twin Lakes Reservoir	Twin Lakes Reservoir T...	Y	2016	01446791	Twin Lakes Reservoir	1827.05658	15	
8	Polygon	8	Silver Lake	Silver Lake Trail	Y	2018	01445599	Silver Lake	902.235941	15	
9	Polygon	2	Lake Blanche	Lake Blanche Trail	N	<Null>	01425755	Lake Blanche	1114.828437	15	1200.905697 61854.601906 3
10	Polygon	73	Lake Solitude	Lake Solitude Trail	Y	2016	01445777	Lake Solitude	464.715944	15	557.926867 19933.337732 3
11	Polygon	4	Dog Lake	Dog Lake Trail	Y	2018	01440503	Dog Lake	425.893484	15	519.68882 16856.218275 3
12	Polygon	6	Lackawaxen Lake	<Null>	N	<Null>	01442387	Lackawaxen Lake	402.902317	15	497.126869 17569.127375 3

OBJECTID	Shape	ToadID	Life_Stage	Gender	Tagged	Day	Month_T	Month	Year	SiteName	Region
4	Point Z	790100289012345	Egg	N/A	N/A	24	May	5	2018	Silver Lake	3
5	Point Z	101231478901235	Adult	M	N	7	August	8	2017	Silver Lake	3
6	Point Z	123452928901235	Adult	F	Y	19	August	8	2017	Silver Lake	3
7	Point Z	145674378901235	Toadlet	F	N	14	June	6	2016	Silver Lake	3

Using the 'Field Site' layer Select "Cecret Lake" relates to 'Trails Partial'. This allows you to find all the trails for a particular sight.

OBJECTID	Shape	Site_ID	FieldName	TrailName	Toads	Year	GNIS_ID	GNIS_Name	SHAPE_Leng	BUFF_DIST	SH
1	Polygon	18	Cecret Lake	Cecret Lake Trail	Y	2017	01445416	Cecret Lake	527.119449	15	
2	Polygon	5	Lake Catherine	Catherine Pass Trail	N	<Null>	01439539	Lake Catherine	451.510467	15	
3	Polygon	72	Lake Martha	Catherine Pass Trail	N	<Null>	01443207	Lake Martha	401.163437	15	
4	Polygon	7	Lake Mary	Lake Mary Trail	Y	2014	01443216	Lake Mary	1810.293672	15	
5	Polygon	116	Lake Florence	Lake Blanche Trail	Y	2018	01428021	Lake Florence	435.29215	15	
6	Polygon	115	Lake Lillian	Lake Blanche Trail	Y	2017	01429613	Lake Lillian	829.233347	15	
7	Polygon	9	Twin Lakes Reservoir	Twin Lakes Reservoir T...	Y	2016	01446791	Twin Lakes Reservoir	1827.05658	15	
8	Polygon	8	Silver Lake	Silver Lake Trail	Y	2018	01445599	Silver Lake	902.235941	15	
9	Polygon	2	Lake Blanche	Lake Blanche Trail	N	<Null>	01425755	Lake Blanche	1114.828437	15	1200.905697 61854.601906 3
10	Polygon	73	Lake Solitude	Lake Solitude Trail	Y	2016	01445777	Lake Solitude	464.715944	15	557.926867 19933.337732 3
11	Polygon	4	Dog Lake	Dog Lake Trail	Y	2018	01440503	Dog Lake	425.893484	15	519.68882 16856.218275 3
12	Polygon	6	Lackawaxen Lake	<Null>	N	<Null>	01442387	Lackawaxen Lake	402.902317	15	497.126869 17569.127375 3

OBJECTID	Shape	PrimaryNam	TrailID	SystemName	Designated	HikeDfnc	RegionID	SHAPE_Leng	Shape_Length
9	Polyline	Cecret Road	OV32875	Cecret Lake Trail	BIKE HIKE		3	69.111125	69.111125
10	Polyline	Cecret Lake	OV481759	Cecret Lake Trail	HIKE	MODERA...	3	755.059683	755.059683
12	Polyline	Cecret Road	OV32875	Cecret Lake Trail	BIKE HIKE		3	471.893948	471.893948

Using the 'DWR Regions' layer, Select region "5" relate to 'DNR stations'. To see which stations are within Region 5.

OBJECTID	Shape	STATE	DWR_Region	Region_Office	Shape_Length	Shape_Area	Region_ID
1	Polygon	Utah	N/A	Utah Main Office	1972354.799438	219796333551.609009	0
14	Polygon	Utah	Central Region	Springville Office	944626.302251	40264319434.120445	3
15	Polygon	Utah	Northeastern Region	Vernal Office	707285.845985	23216038979.485958	2
17	Polygon	Utah	Southern Region	Cedar City	1127794.279312	70432237475.947678	5
18	Polygon	Utah	Southeastern Region	Price Office	1206396.5366	52564457329.362137	4
19	Polygon	Utah	Northern Region	Ogden Office	1066515.535204	33232059625.479595	1

OBJECTID	Shape	Region_ID	Region	Office_Name	Office_Type	Lat	Long	PhoneNumber	Address
6	Point	5	Southern Region	Cedar City Office	Region	37.704132	-113.086484	435-865-6100	1470 N Airport Rd, Ced...
7	Point	5	Washington County Fi...	Washington County Fi...	Field	37.179394	-113.395464	435-879-8694	451 N SR-318, Hurrica...

Screenshot of Geodatabase with relationship classes

- Databases
  - Database Project Gfeller.gdb
    - Image\_Mensuration
    - BorealToadData
    - ChytridSite\_XY
    - ConservationLocations\_XY
    - ConservationLocations\_XY\_RelocationSit
    - DEM\_Utah
      - DNR\_Stations
      - DWR\_Regions
      - DWR\_Regions\_BorealToadData
      - DWR\_Regions\_ChlytridSite\_XY
      - DWR\_Regions\_DNR\_Stations
      - DWR\_Regions\_FieldSite
      - FieldSite
      - FieldSite\_BorealToadData
      - FieldSite\_FieldSite\_Point
      - FieldSite\_LakesPartial
      - FieldSite\_Point
      - FieldSite\_Trails\_Partial
      - LakesPartial
      - RelocationSites
      - Trails\_Partial
      - Utah