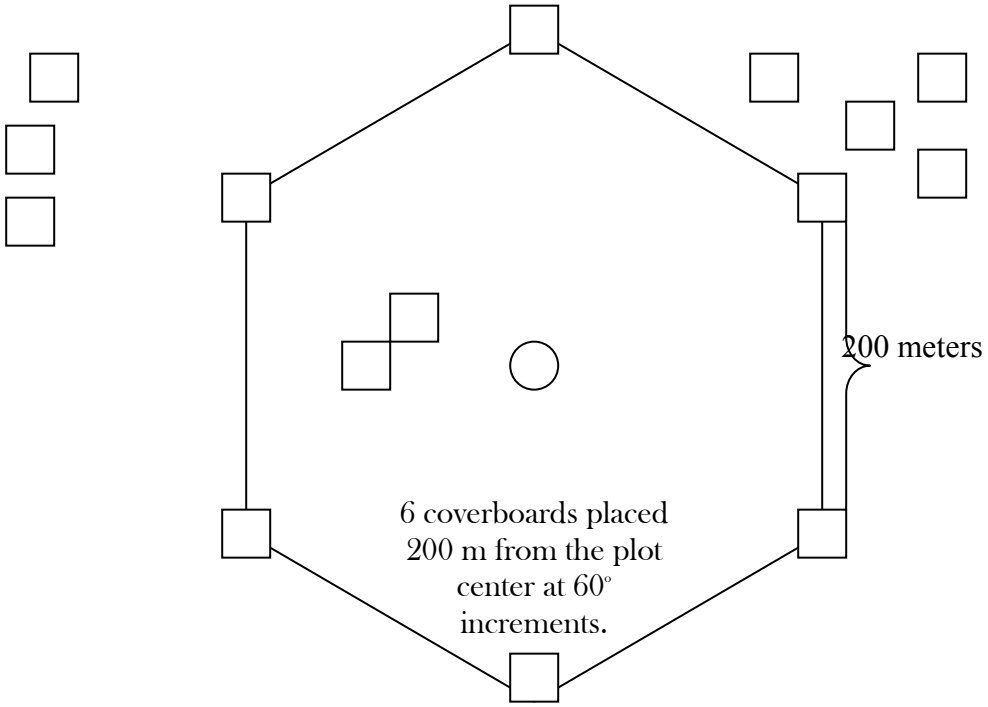
Chapter Ten
Amphibian & Reptile Monitoring Protocol

IOWA AMPHIBIAN AND REPTILE MONITORING:

Visual encounter surveys (VES) will be one of the 3 methods used in this protocol. VES is inexpensive, easy to implement, and efficient over diverse habitats (Manley et al. 2004). Additional benefits of VES include low site disturbance, low animal mortality, ease of implementation in terrestrial or aquatic environments, and other animals can be detected at the same time. The entire 26 acre (10 hectare) hexagon will serve as the primary sampling unit with additional sites being located outside of the hexagon but within the 101 ha block surrounding the center point. This area is much larger than that usually incorporated into a VES, but will allow for a large variety of habitat types to be searched.



Two other methods used in this protocol include cover boards and minnow traps. The diagram above shows the placement of cover boards. Minnow traps should be deployed in wetlands for 3 days (Kolozsvary and Swihart 1999) and checked daily.

SURVEY METHODS:

Each of the sampling sites will be subjected to a VES of 4 hours total per visit. This 4 hour timeframe may be broken into 2 hours with 2 technicians, 1 hour with 4 technicians, etc. Sites should be visited at least twice between mid-April and mid-June (quasi-spring), mid-June and mid-August (summer), and again mid-August and mid-October (quasi-fall), for at total of at least 6 visits per year. There should be a 2 week lag between all site visits. Since the goal is to find as many species of amphibians and reptiles as possible, searches should be focused on areas within and around the hexagon that appear to be suitable for these animals. For example, areas

with rocks or logs that can be turned over should take precedence over areas that have no suitable cover. In addition, wetlands should be walked to a reasonable depth (the shoreline to about a 0.5 meter depth) to search for egg masses, larvae, and amplexed frogs.

In the wetland areas, surveys are conducted by walking the edge of the water body, and zigzagging through wet meadow habitat. Two technicians can walk in opposite directions around a water body, ending the survey when they meet. If water is too deep to walk through, technicians stay on the edge of the water body. The entire wet meadow area should be searched. For streams, one technician surveys each side (a 500 m stretch, moving upstream from the starting point), simultaneously.

It is expected that technicians will spend approximately 15 minutes per 100 m of transect, stopping the stopwatch when extra time is needed for species ID or to move around obstacles (Manley et al. 2004). Searches are conducted using long-handled dipnets, and overturning logs and rocks.

Coverboards are used as a source of cover by many species of herpetofauna (Corn 1994, Bennett et al. 2003). Typical size should be a 1-m^2 sheet that is at least 1 cm thick. Six coverboards should be placed approximately 200 meters from the center of the sample plot in the 6 directions of the point count stations. This means the first coverboard should be placed due north, 200 m from the center of the plot. Every 60 degrees (so, 0^o, 60^o, 120^o, 180^o, 240^o, and 300^o), another board should be placed 200 m from the plot center. Incidentally, this coincides with the placement of the poles to mark the bird point count locations. Place the board 1-2 meters from the pole to prevent accidental stepping on the coverboard. Coverboard placement may require the removal of litter on the surface as the coverboard should be flush with the soil (Manley et al. 2004). However, place some coverboards on litter/vegetation as this may provide additional cover snakes would find attractive. Compare capture numbers under the 'bare' and 'vegetated' coverboards to decide which would be most appropriate on each site. Nine additional coverboards should be placed in suitable habitat to attract snakes. Locations of these boards should be recorded with a GPS unit and marked to allow them to be found in the future.

Minnow traps may be an effective way to find additional tadpoles (Shaffer et al. 1994). Minnow traps should be deployed in water at least 0.5 m but not more than 2 m deep. Place an empty, capped plastic soda bottle in the trap to keep an area buoyant, allowing the animals to get oxygen. Traps should be checked daily and left in the water for 3 days (2 nights). Traps should be set at least once per each of the three seasons. This can be done concurrently with one of the VESs for each season. Turtle-traps should be deployed concurrently with the minnow traps and checked daily.

To protect the amphibian, it is critical that the technician's hands be free of any chemicals or lotions. Insect repellent can be absorbed through the skin of the amphibian, resulting in the animal's death.

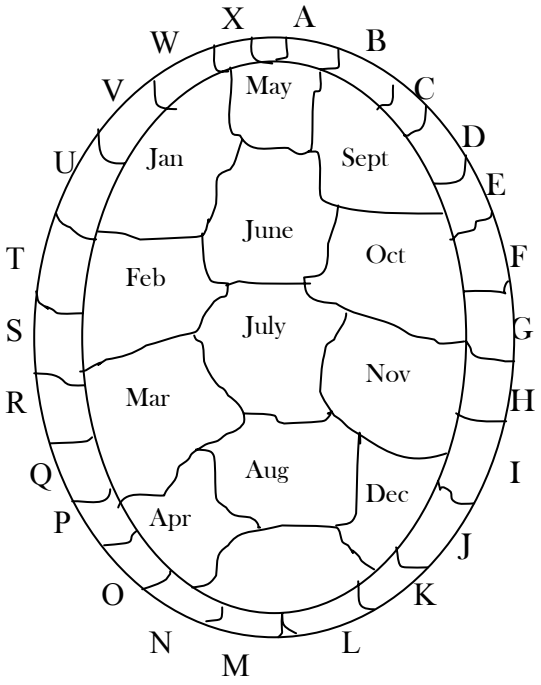
For each observation, record the time, the amount of time that has elapsed from the start of the search, species, detection type (visual, auditory, sign), age class (adult, sub-adult, juvenile), and substrate type (rock, log, bare ground, etc.). In addition, animals that are captured should be

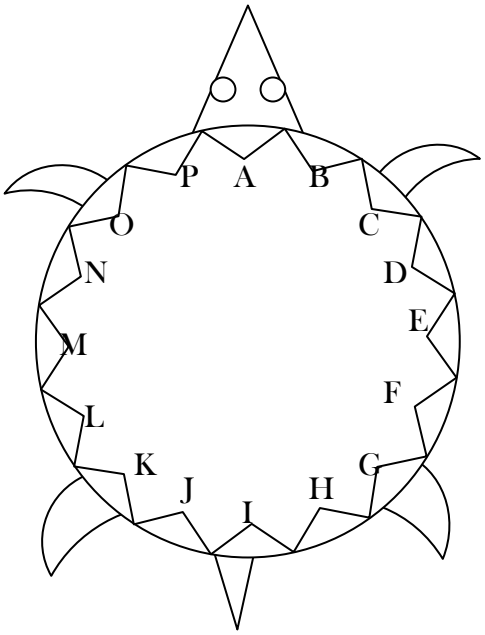
measured (snout to vent and total length), assigned to sex and status, and marked. Animals found dead on the road or dead in a trap should be kept as voucher specimen. Place these animals in a plastic bag, label the bag with the day, location and species, and freeze until transport to either the IDNR diversity program or another designated facility. Bags should be kept on ice when transporting. For living captures, photo documentation should be made of each new species for a property, including common species. Follow the guidelines in Appendix 3 (Herpetofauna Photo Voucher Guidelines) for amphibian and reptile photo vouchers.

Snakes and lizards can be marked by placing a dot of nail polish on the back. Turtles should be marked using a shell notch system (see Appendix 3). Notches can be created using a 3-sided file. By marking 1 to 3 marginal scutes, over 10,000 animals can be given a unique mark for Emydidae and Chelydridae turtles. Kinosternidae turtles are more difficult to mark as several of the marginal scutes are not broad enough to use a 3-edge file. In this situation, approximately 4,000 turtles can be marked individually. Unless more than 4,000 turtles of a given species are expected to be captured, following the marking codes in Appendix 3 regardless of family is advisable. Once these marks have all been assigned to individuals, further marks using the scutes labeled D, E, F, G, R, S, T, and U can be designed. With all turtles, a paint pen or fingernail polish can be used to indicate which month a turtle was captured. A paint pen could be used to write the year of capture in the costal or vertebral scute corresponding to the month of capture. Baby turtles can be batch marked by a small shell notch created with fingernail clippers. The marking system for Trionychidae (softshell turtles) is illustrated on the next page. Amphibians could be marked with either toe-clipping (cheaper) or VIE depending on how often a site is expected to be visited. In most situations it probably is not feasible to mark amphibians, due to the typically short amount of time for which they would be capture-able. Salamanders, however, should be marked if the site is expected to be visited each year.

Shell marking diagram for turtles.

Use a 3-edge file to mark the marginal scutes. Always count the number of marginal scutes on each side before marking the turtle. The top marginal scutes will always be "A" & "X". The posterior 2 are always "L" & "M". In addition to the individual mark using these scutes, a dot of paint (from a paint pen or fingernail polish) can be applied to the costal or vertebral scutes to indicate the month of capture.





Marking diagram for softshell turtles.

Scute marks should be more slender than indicated in the diagram. Marks should be wide enough to be visible only (< 5 mm at the widest outer edge). Use a 3-edge file to mark the marginal scutes.

From Michael Dorcas's website Last accessed 11/7/06
http://www.bio.davidson.edu/people/midorcas/research/Contribute/HerpLabProtocols2006-09-22.pdf

Nocturnal Auditory Amphibian Counts

In addition to the VES, each sample plot should be visited one night during each of 3 'seasons'. This would follow the methodology used in the Iowa Frog and Toad Survey protocol, except the locations would be in the permanent sampling plots as opposed to being close to roads. The technicians would visit areas with standing water within the sampling plot, at night, and listen at each wetland for 5 minutes. All calls heard would be recorded for each species and given an 'index ranking' of 1, 2, or 3 depending upon the number of individuals heard. A ranking of 1 is equal to being able to count the number of individuals, there should be space between the calls. A ranking of 2 is equal to being able to distinguish individuals but there should be overlap between the calls. A ranking of 3 would mean that it is a full chorus of calling, with constant, continuously overlapping sounds. Ideally, these visits would be conducted at least twice, preferably 3 times during the 'spring' (mid-April through mid-June) and the 'summer' (mid-June through mid-July) seasons. In actuality, each site should be visited at least once during April, once between May 7 and June 4, and once between June 13 and July 10. If conditions and resources are available for additional visits during these timeframes, those visits should be made.

HABITAT AND PLANT SPECIES COMPOSITION DATA COLLECTION:

It is expected that the data collected at the center of the hexagon and at each of the 6 hexagon-points will adequately describe the terrestrial component of the area. However, additional measurements are expected to be needed from wetlands searched as part of the VES and trapping design. In depth details concerning the aquatic data acquisition can be found in Chapter 20 (Aquatic Habitat Classification). That chapter includes information on collecting data on the habitats stratified into a wetland classification (i.e. river, stream, creek, impoundment, lake, etc.). The sampling plot may be classified as a prairie or lake stratification.

If so, the primary habitat measurements would be acquired following Chapter 19 (Terrestrial Plant Species and Habitat Monitoring) and Chapter 20. Any additional wetlands (i.e. creeks, streams, ponds, etc.) which were surveyed for amphibians and reptiles would also need to have aquatic habitat characteristics measured. These measurements should be collected as outlined in Chapter 20. In addition to these measurements are data that can be determined from GIS coverages in the lab prior to field work (see Chapter 3 GPS & GIS Coverage). Measurements include amount of roads and other impacted soils adjacent to the water body, locations of, and numbers of water bodies. These will still need to be ground-truthed in the field.

EQUIPMENT LIST:
Kestrel temperature and wind gauge
Water thermometer and pH meter
Pair leather gloves (for large snake captures)
Hand spades or rake
Field guides & Anuran call tape for reference (leave in truck)
Hand lens
Stop watches
Digital camera
Snake sticks
Snake tubes for handling venomous snakes
Pair hip waders
15 Coverboards
Minnow traps
Frye nets
Hoop traps for turtles
Animal marking equipment: Nail polish, 3-edged file, cuticle scissors, &/or VIE, CWT, PIT
Standard field kit: Clip board, pencils, ruler, small scissors, Sharpie markers, hand sanitizer, plastic ziplock baggies & data sheets.

STAFF & TRAINING:
Two weeks of training is recommended and should include 1) field guide use and id, 2) trips to University museums to discuss defining species characteristics, 3) field practice with an experienced observer, and 4) proficiency testing. Also need training on habitat data collection.

DATA QUALITY & MANAGEMENT:
VES can be difficult to rate for quality:

- Examination of data will not reveal missed detections or misidentifications.
    - Misidentifications could be checked by either the use of digital cameras, or by the field supervisor working periodically with each technician.
- Manley et al. (2004) suggests rotating crew member such that each site is visited by more than one crew to reduce the effect of observer bias.
- All photographs should be reviewed by at least 2 additional people to verify species identifications.

At the end of each trapping day, field crew pairs should review data sheets to ensure all information present. At the end of the week, the field crew leader should review the data sheets for ID, escape and mortality rates, and legibility.

DATA ANALYSIS:
The basic information should allow the creation of a species list for each site, and data should at least be used to estimate the proportion of points occupied using programs MARK or PRESENCE (see Chapter 5, Data Analysis). The nocturnal auditory call data collected would also be analyzed using program MARK or PRESENCE to determine the proportion of areas occupied. Current technology lacks the ability to rigorously analyze the call index data, but we believe that advances in methodology will soon allow this analysis.

The species list can be used to calculate basic diversity indices. Depending on the numbers of animals recaptured, the data may also be able to be used to estimate population size, although this is unlikely. See Chapter 5 for additional information.

SAFETY CONSIDERATIONS:

Venomous Snakes

Never reach underneath a coverboard, rock, or other substrate covering without first flipping it over to see what is underneath. These animals will most likely be rare enough that they may not need to be marked, and therefore would not need to be handled. If possible, photograph the animal such that the coloration of the dorsal (back) surface can be compared to subsequent captures with photographic-pattern-recognition software. If, however, there is reason to mark these animals (probably with passive integrated transponders (PIT–tags)), the safest way to handle a venomous snake is to use a snake stick to place it into a plastic container (such as a Rubbermaid container at least 43 cm deep). Then, using a snake tube, entice the snake to climb into the tube. Once it is in far enough that it cannot scrunch backwards to escape and yet not in so far as to come out the other end, grasp the belly of the snake at the end of the tube. This immobilizes the snake so it can be properly marked and measured. However, do not attempt this unless you have been trained. As stated above, most likely venomous snakes will not need to be handled, but do photograph it (from a safe distance without disturbing it) if possible.

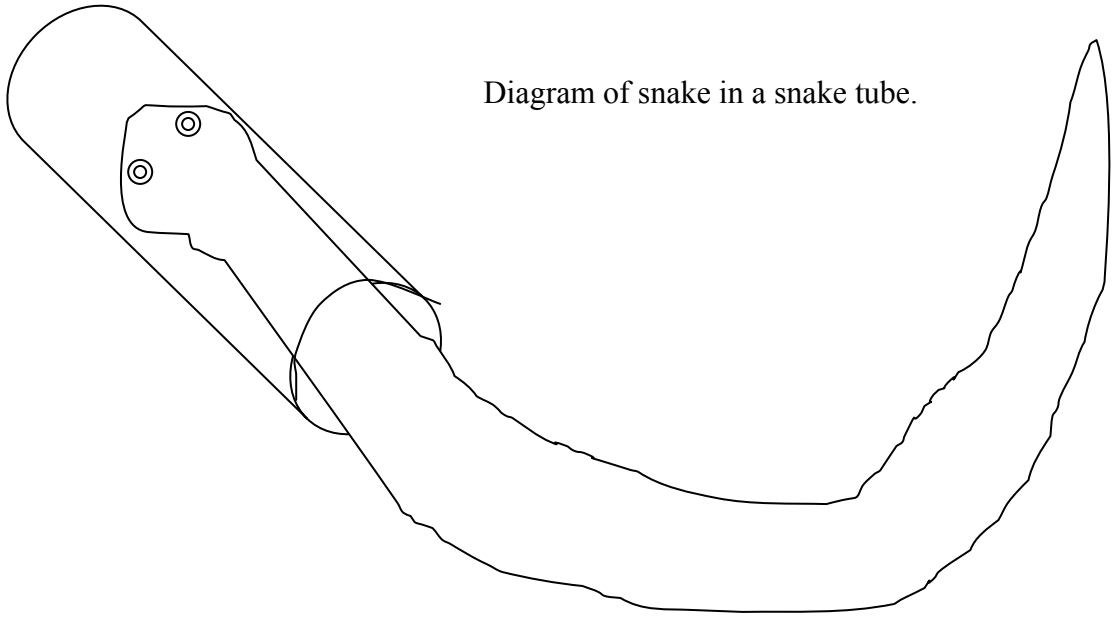


Diagram of snake in a snake tube.

Hygiene

Several amphibian species, particularly toads, are capable of producing an irritant from their skin. Do not rub your eyes or face or eat after handling an amphibian without first washing your hands. Should you get the amphibian secretion in your eye (it will burn), wash with water immediately. If this does not help, seek medical treatment.

Care should be taken in order to lessen the probability of spreading an infectious agent, such as a fungus or virus, between wetlands. One way to reduce the chance of spreading an infectious agent between wetlands is to allow the waders to dry for 3-4 days between sites. This may be impractical given the short time frame available for aquatic surveying in Iowa. As an alternative, it may be best to rinse all equipment with a solution of hot water and bleach.

TARGET SPECIES:

The following list of target species represents the species of greatest conservation concern as chosen by the Steering committee for the Iowa Comprehensive Wildlife Conservation Plan (Zohrer et al. 2005). Distribution maps for these species can be found in The Salamanders and Frogs of Iowa (Christiansen and Bailey 1991), The Snakes of Iowa (Christiansen and Bailey 1990), The Lizards and Turtles of Iowa (Christiansen and Bailey 1997), and also in Iowa GAP (Kane et al. 2003). Appendix A contains a list of additional, more common, herpetofauna species which may be encountered during the monitoring efforts.

Target amphibian species:

Common Name	Scientific Name	Habitat
Mudpuppy	*Necturus maculosus*	Clean rivers, streams, lakes, reservoirs
Central newt	*Notophthalmus viridescens*	Vegetated woodland ponds, roadside flooded ditches, & adjacent habitat
Smallmouth salamander	*Ambystoma texanum*	Woodland pools, open woods
Blue-spotted salamander	*Ambystoma laterale*	Woodland pools, open woods
Crawfish frog	*Rana areolata*	Prairie marshes, ponds, river floodplains
Cricket frog	*Acris crepitans*	Shallow wetlands & streams
Great plains toad	*Bufo cognatus*	Prairie, nonnative grassland

Target reptile species:

Common Name	Scientific Name	Habitat
Ornate box turtle	*Terrepene ornata*	Sand prairies, savanna
Blanding's turtle	*Emydoidea blandingii*	Shallow, well vegetated wetlands
Wood turtle	*Clemmys insculpta*	Floodplain forest, rivers
Alligator snapping turtle	*Macroclemys temmincki*	Large rivers
Yellow mud turtle	*Kinosternon flavescens*	Shallow, ephemeral pools, adjacent areas with nearly pure sand soils
Common musk turtle	*Sternotherus odoratus*	Backwaters and spring fed ponds adjacent to sandy uplands

Target reptile species, continued:

Common Name	Scientific Name	Habitat
Slender glass lizard	*Ophisaurus attenuatus*	Prairie, pasture, forest edge, savanna
Six-lined racerunner	*Cneimidophorus sexlineatus*	Sand prairies, savanna
Northern prairie skink	*Eumeces septentrionalis*	Sandy prairie-forest edge, wetland edge
Great plains skink	*Eumeces obsoletus*	Rocky prairie, forest edge
Diamondback water snake	*Nerodia rhombifera*	Quiet pools and backwater sloughs
Yellowbelly water snake	*Nerodia erythrogaster flavigaster*	Backwater sloughs and forested wetlands
Copperbelly water snake	*Nerodia erythrogaster neglecta*	Backwater sloughs and forested wetlands
Smooth earth snake	*Virginia valeriae*	Rocky woodland
Western worm snake	*Carphophis amoenus*	Rocky woodland
Smooth green snake	*Opheodrys vernalis*	Old field, savanna, wet prairie, marsh
Prairie kingsnake	*Lampropeltis calligaster*	Woodland edge, open woodland, grassland, savanna
Speckled kingsnake	*Lampropeltis getulus*	Prairie, woodland edge, savanna
Bullsnake	*Pituophis catenifer sayi*	Prairie, deciduous woodland edge, savanna
Western hognose snake	*Heterodon nasicus*	Sand prairie
Eastern massasauga rattlesnake	*Sistrurus catenatus catenatus*	Early successional wetland, upland grassland
Timber rattlesnake	*Crotalus horridus*	Forested areas near rock outcrops, woodland, hill prairie
Prairie rattlesnake	*Crotalus viridis*	Prairie
Copperhead	*Agkistrodon contortrix*	Forested, rocky hillsides

ADDITIONAL METHODS FOR SPECIAL LOCATIONS:

The following are additional techniques which may be implemented at certain sites **in addition** to the core methods described above. These could be used in areas where there are known populations of species of concern or when supplemental funding has been acquired for a given area. However, the basic core protocol must still be followed to allow for comparison of all sites, both across the state of Iowa and also for a regional comparison, provided that other states or areas are following the same protocol.

VES Augmentation

1). Nocturnal surveys – Conduct at least one additional search at night to detect those species most active at night.

2). Extend the survey time – In habitats with many species of amphibians and reptiles, it may be necessary to increase the amount of time each crew

spends looking for animals, but the data will need to be recorded such that the first 4 hours (2 for each technician) can be extracted for comparisons to other areas.

Pitfall Trapping

Pitfall traps with (or without) drift fences are time consuming to install. They also only catch species that are not able to jump or crawl out, mostly limiting there use to salamanders, toads, small snakes, and some lizards. They can result in high mortality for small mammals, or herpetofauna if not checked daily. Should the decision be made to include pitfall traps into the monitoring regime, several references (Corn 1994, Karraker 2001, and Manley et al. 2004 draft) should be incorporated into the design.

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Amphibian and Reptile VES. DATE:_____ OBS:_____ LOCATION:_____ pg___of___

Start temp (C):_____ End temp (C):_____ %clouds:_____ Rain:_____ Wind speed:_____ Start time:_____ End time:_____

Area corresponds to the GIS map of the Location being surveyed. Each map should have wetlands numbered. If the area being searched or where an animal is encountered is not marked on the map, record NM in this column. Wind speed codes: 0=no movement; 1= calm, smoke drifts; 2=light, feel on face, leaves rustle; 3=gentle, leaves in constant motion, flags extend; 4=moderate, dust and paper rises; 5=fast, small trees sway, crested wavelets on water. Det. Type=Detection type: v=visual; c=capture; a=auditory; s=sign. Sub.=Subsrate type: R=rock; L=log; W=water; V=vegetation; X=litter. Age: A=adult; M=metamorph; L=tadpole; E=egg mass. Sex: M/F/U.

Status: G=gravid; S=swollen testes; otherwise leave this column blank.

Area	Time				Species				Det. type	Sub.	Mark	Total length				SVL				Age	Sex	Status	Other

Data entered by:____ checked by:____

IOWA FROG AND TOAD SURVEY

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OBSERVER'S NAME(S)

RUN 1 _____ ROUTE NO. _____

RUN 2 _____ YEAR _____

RUN 3 _____ COUNTY _____

RUN 1: April 1-28 / Water 50°

DATE: _____

Begin Survey		End Survey	
Time:		Time:	
Wind:		Wind:	
Air Temp:		Air Temp:	
Sky:		Sky:	

SITE NAME	Dry/Wet	Water Temp	Wood Frog	Chorus Frog	Spring Peeper	Crawfish Frog	Leopard Frog *	Pickerel Frog	American Toad	Gr. Plains Toad	E. Tree Frog	Cope's Tree Frog	Cricket Frog	Woodhouse's Toad **	Plains Spadefoot	Green Frog	Bullfrog
1-																	
2-																	
3-																	
4-																	
5-																	
6-																	
7-																	
8-																	

RUN 2: May 7-June 4 / Water 60°

DATE: _____

Begin Survey		End Survey	
Time:		Time:	
Wind:		Wind:	
Air Temp:		Air Temp:	
Sky:		Sky:	

SITE NAME	Dry/Wet	Water Temp	Wood Frog	Chorus Frog	Spring Peeper	Crawfish Frog	Leopard Frog *	Pickerel Frog	American Toad	Gr. Plains Toad	E. Tree Frog	Cope's Tree Frog	Cricket Frog	Woodhouse's Toad **	Plains Spadefoot	Green Frog	Bullfrog
1-																	
2-																	
3-																	
4-																	
5-																	
6-																	
7-																	
8-																	

RUN 3: June 13- July 10 / Water 70°

DATE: _____

Begin Survey		End Survey	
Time:		Time:	
Wind:		Wind:	
Air Temp:		Air Temp:	
Sky:		Sky:	

SITE NAME	Dry/Wet	Water Temp	Wood Frog	Chorus Frog	Spring Peeper	Crawfish Frog	Leopard Frog *	Pickerel Frog	American Toad	Gr. Plains Toad	E. Tree Frog	Cope's Tree Frog	Cricket Frog	Woodhouse's Toad **	Plains Spadefoot	Green Frog	Bullfrog
1-																	
2-																	
3-																	
4-																	
5-																	
6-																	
7-																	
8-																	

Sky Codes	
0-	Clear or few clouds
1-	Partly cloudy or variable
2-	cloudy or overcast
3-	Fog
4-	Drizzle
5-	Rain shower

Wind Codes	
0-	0 mph, no movement
1-	1-3 mph, Calm. Smoke drifts
2-	4-7 mph, Light. Fell on face, leaves rustle, wind vanes move.
3-	8-12mph, Gentle. Leaves/twigs in constant motion, flag extends.
4-	13-18mph, Moderate. Dust and paper raised. Branches in motion.
5-	19-24mph, Fresh. Small trees sway, crested wavelets on water.

Relative Call Index Codes

0- No individuals heard.

1- Individuals can be counted. There may be space between calls.

2- Calls of individuals can be distinguished, but there is some overlapping.

3- Full chorus of calls. Constant, continuous, and overlapping.

Comments:

* Leopard Frog includes Northern, Plains, and Southern. Please verify and note any confirmed sightings.

** Woodhouse's includes Fowler's toad.

Nocturnal frog call data sheet. DATE:_____ OBS:_____ pg___of___
LOCATION:_____Start air temp (C):_____ End air temp (C):_____
%clouds:_____ Rain:_____ Wind:_____ Start time:_____ End time:_____

Area corresponds to the GIS map of the Location being surveyed. Each map should have wetlands numbered. If the area being searched or where an animal is encountered is not marked on the map, record NM in this column. Wind speed codes: 0=no movement; 1= calm, smoke drifts; 2=light, feel on face, leaves rustle; 3=gentle, leaves in constant motion, flags extend; 4=moderate, dust and paper rises; 5=fast, small trees sway, crested wavelets on water. Calling index: 1=Individuals can be counted; 2=overlap in calls; 3=full chorus, continuous and overlapping.

Area	Dry/wet	Water temp	Species	Calling index

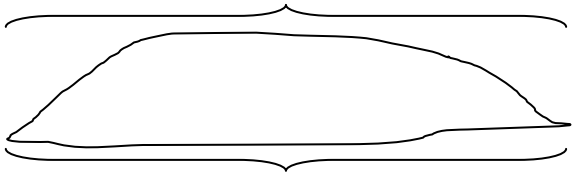
Notes on other wildlife encountered tonight:

Data entered by:____ checked by:____

Lab sheet for turtle marking:

Species:_____ Site/area/county:_____Page_____

Side view of turtle shell



P

Date	Exact location	Capture method	MARK ID	Plastron length (cm)	Weight (g)	Comments

Turtle, minnow, and all species trap data sheet. DATE:_____ OBS:_____ LOCATION:_____ pg___
Start temp (C):_____ End temp (C):_____ %clouds:_____ Rain:_____ Wind speed:_____ Start time:_____ End time:_____

Area	Trap type		Trap #		Species				Common name	Number caught		Mark?	Measure?	Comments

Data entered by:____ checked by:____

Marking codes for turtles:

2 scutes marked = 120 individual marks:

AB	BC	CH	HI	IJ	JK	KL	LM	MN	NO	OP	PQ	QV	VW	WX
AC	BH	CI	HJ	IK	JL	KM	LN	MO	NP	OQ	PV	QW	VX	
AH	BI	CJ	HK	IL	JM	KN	LO	MP	NQ	OV	PW	QX		
AI	BJ	CK	HL	IM	JN	KO	LP	MQ	NV	OW	PX			
AJ	BK	CL	HM	IN	JO	KP	LQ	MV	NW	OX				
AK	BL	CM	HN	IO	JP	KQ	LV	MW	NX					
AL	BM	CN	HO	IP	JQ	KV	LW	MX						
AM	BN	CO	HP	IQ	JV	KW	LX							
AN	BO	CP	HQ	IV	JW	KX								
AO	BP	CQ	HV	IW	JX									
AP	BQ	CV	HW	IX										
AQ	BV	CW	HX											
AV	BW	CX												
AW	BX													
AX														

Marking codes for turtles:
3 scutes marked = 560 individual marks:

ABC	ACW	AJK	ALW	AQW	BHP	BJX	BNO	CHM	CJQ	CMV	HIK	HKQ	HOP
ABH	ACX	AJL	ALX	AQX	BHQ	BKL	BNP	CHN	CJV	CMW	HIL	HKV	HOQ
ABI	AHI	AJM	AMN	AVW	BHV	BKM	BNQ	CHO	CJW	CMX	HIM	HKW	HOV
ABJ	AHJ	AJN	AMO	AVX	BHW	BKN	BNV	CHP	CJX	CNO	HIN	HKX	HOW
ABK	AHK	AJO	AMP	AWX	BHX	BKO	BNW	CHQ	CKL	CNP	HIO	HLM	HOX
ABL	AHL	AJP	AMQ	BCH	BIJ	BKP	BNX	CHV	CKM	CNQ	HIP	HLN	HPQ
ABM	AHM	AJQ	AMV	BCI	BIK	BKQ	BOP	CHW	CKN	CNV	HIQ	HLO	HPV
ABN	AHN	AJV	AMW	BCJ	BIL	BKV	BOQ	CHX	CKO	CNW	HIV	HLP	HPW
ABO	AHO	AJW	AMX	BCK	BIM	BKW	BOV	CIJ	CKP	CNX	HIW	HLQ	HPX
ABP	AHP	AJX	ANO	BCL	BIN	BKX	BOW	CIK	CKQ	COP	HIX	HLV	HQV
ABQ	AHQ	AKL	ANP	BCM	BIO	BLM	BOX	CIL	CKV	COQ	HJK	HLW	HQW
ABV	AHV	AKM	ANQ	BCN	BIP	BLN	BPQ	CIM	CKW	COV	HJL	HLX	HQX
ABW	AHW	AKN	ANV	BCO	BIQ	BLO	BPV	CIN	CKX	COW	HJM	HMN	HVW
ABX	AHX	AKO	ANW	BCP	BIV	BLP	BPW	CIO	CLM	COX	HJN	HMO	HVX
ACH	AIJ	AKP	ANX	BCQ	BIW	BLQ	BPX	CIP	CLN	CPQ	HJO	HMP	HWX
ACI	AIK	AKQ	AOP	BCV	BIX	BLV	BQV	CIQ	CLO	CPV	HJP	HMQ	IJK
ACJ	AIL	AKV	AOQ	BCW	BJK	BLW	BQW	CIV	CLP	CPW	HJQ	HMV	IJL
ACK	AIM	AKW	AOV	BCX	BJL	BLX	BQX	CIW	CLQ	CPX	HJV	HMW	IJM
ACL	AIN	AKX	AOW	BHI	BJM	BMN	BVW	CIX	CLV	CQV	HJW	HMX	IJN
ACM	AIO	ALM	AOX	BHJ	BJN	BMO	BVX	CJK	CLW	CQW	HJX	HNO	IJO
CAN	AIP	ALN	APQ	BHK	BJO	BMP	BWX	CJL	CLX	CQX	HKL	HNP	IJP
ACO	AIQ	ALO	APV	BHL	BJP	BMQ	CHI	CJM	CMN	CVW	HKM	HNQ	IJQ
ACP	AIV	ALP	APW	BHM	BJQ	BMV	CHJ	CJN	CMO	CVX	HKN	HNV	IJV
ACQ	AIW	ALQ	APX	BHN	BJV	BMW	CHK	CJO	CMP	CWX	HKO	HNW	IJW
ACV	AIX	ALV	AQV	BHO	BJW	BMX	CHL	CJP	CMQ	HIJ	HKP	HNX	IJX

Marking codes for turtles:
3 scutes marked = 560 individual marks (continued from previous page):

IKL	INP	JKQ	JOP	KMP	KWX	LQX	NOP	PQV
IKM	INQ	JKV	JOQ	KMQ	LMN	LVW	NOQ	PQW
IKN	INV	JKW	JOV	KMV	LMO	LVX	NOV	PQX
IKO	INW	JKX	JOW	KMW	LMP	LWX	NOW	PVW
IKP	INX	JLM	JOX	KMX	LMQ	MNO	NOX	PVX
IKQ	IOP	JLN	JPQ	KNO	LMV	MNP	NPQ	PWX
IKV	IOQ	JLO	JPV	KNP	LMW	MNQ	NPV	QVW
IKW	IOV	JLP	JPW	KNQ	LMX	MNV	NPW	QVX
IKX	IOW	JLQ	JPX	KNV	LNO	MNW	NPX	QWX
ILM	IOX	JLV	JQV	KNW	LNP	MNX	NQV	VWX
ILN	IPQ	JLW	JQW	KNX	LNQ	MOP	NQW	
ILO	IPV	JLX	JQX	KOP	LNV	MOQ	NQX	
ILP	IPW	JMN	JVW	KOQ	LNW	MOV	NVW	
ILQ	IPX	JMO	JVX	KOV	LNX	MOW	NVX	
ILV	IQV	JMP	JWX	KOQ	LOP	MOX	NWX	
ILW	IQW	JMQ	KLM	KOX	LOQ	MPQ	OPQ	
ILX	IQX	JMV	KLN	KPQ	LOV	MPV	OPV	
IMN	IVW	JMW	KLO	KPV	LOW	MPW	OPW	
IMO	IVX	JMX	KLP	KPW	LOX	MPX	OPX	
IMP	IWX	JNO	KLQ	KPX	LPQ	MQV	OQV	
IMQ	JKL	JNP	KLV	KQV	LPV	MQW	OQW	
IMV	JKM	JNQ	KLW	KQW	LPW	MQX	OQX	
IMW	JKN	JNV	KLX	KQX	LPX	MVW	OVW	
IMX	JKO	JNW	KMN	KVW	LQV	MVX	OVX	
INO	JKP	JNX	KMO	KVX	LQW	MWX	OWX	

Marking codes for turtles:
4 scutes marked = 1,799 individual marks:

ABCH	ABIJ	ABKP	ABNX	ACHV	ACKM	ACNQ	AHIP	AHLN	AHPQ	AIKQ	AIOP	AJLN	AJPQ
ABCI	ABIK	ABKQ	ABOP	ACHW	ACKN	ACNV	AHIQ	AHLO	AHPV	AIKV	AIOQ	AJLO	AJPV
ABCJ	ABIL	ABKV	ABOQ	ACHX	ACKO	ACNW	AHIV	AHLP	AHPW	AIKW	AIOV	AJLP	AJPW
ABCK	ABIM	ABKW	ABOV	ACIJ	ACKP	ACNX	AHIW	AHLQ	AHPX	AIKX	AIOW	AJLQ	AJPX
ABCL	ABIN	ABKX	ABOW	ACIK	ACKQ	ACOP	AHIX	AHLV	AHQV	AILM	AIOX	AJLV	AJQV
ABCM	ABIO	ABLM	ABOX	ACIL	ACKV	ACOQ	AHJK	AHLW	AHQW	AILN	AIPQ	AJLW	AJQW
ABCN	ABIP	ABLN	ABPQ	ACIM	ACKW	ACOV	AHJL	AHLX	AHQX	AILO	AIPV	AJLX	AJQX
ABCO	ABIQ	ABLO	ABPV	ACIN	ACKX	ACOW	AHJM	AHMN	AHVW	AILP	AIPW	AJMN	AJVW
ABCP	ABIV	ABLP	ABPW	ACIO	ACLM	ACOX	AHJN	AHMO	AHVX	AILQ	AIPX	AJMO	AJVX
ABCQ	ABIW	ABLQ	ABPX	ACIP	ACLN	ACPQ	AHJO	AHMP	AHWX	AILV	AIQV	AJMP	AJWX
ABCV	ABIX	ABLV	ABQV	ACIQ	ACLO	ACPV	AHJP	AHMQ	AIJK	AILW	AIQW	AJMQ	AKLM
ABCW	ABJK	ABLW	ABQW	ACIV	ACLP	ACPW	AHJQ	AHMV	AIJL	AILX	AIQX	AJMV	AKLN
ABCX	ABJL	ABLX	ABQX	ACIW	ACLQ	ACPX	AHJV	AHMW	AIJM	AIMN	AIVW	AJMW	AKLO
ABHI	ABJM	ABMN	ABVW	ACIX	ACLV	ACQV	AHJW	AHMX	AIJN	AIMO	AIVX	AJMX	AKLP
ABHJ	ABJN	ABMO	ABVX	ACJK	ACLW	ACQW	AHJX	AHNO	AIJO	AIMP	AIWX	AJNO	AKLQ
ABHK	ABJO	ABMP	ABWX	ACJL	ACLX	ACQX	AHKL	AHNP	AIJP	AIMQ	AJKL	AJNP	AKLV
ABHL	ABJP	ABMQ	ACHI	ACJM	ACMN	ACVW	AHKM	AHNQ	AIJQ	AIMV	AJKM	AJNQ	AKLW
ABHM	ABJQ	ABMV	ACHJ	ACJN	ACMO	ACVX	AHKN	AHNV	AIJV	AIMW	AJKN	AJNV	AKLX
ABHN	ABJV	ABMW	ACHK	ACJO	ACMP	ACWX	AHKO	AHNW	AIJW	AIMX	AJKO	AJNW	AKMN
ABHO	ABJW	ABMX	ACHL	ACJP	ACMQ	AHIJ	AHKP	AHNX	AIJX	AINO	AJKP	AJNX	AKMO
ABHP	ABJX	ABNO	ACHM	ACJQ	ACMV	AHIK	AHKQ	AHOP	AIKL	AINP	AJKQ	AJOP	AKMP
ABHQ	ABKL	ABNP	ACHN	ACJV	ACMW	AHIL	AHKV	AHOQ	AIKM	AINQ	AJKV	AJOQ	AKMQ
ABHV	ABKM	ABNQ	ACHO	ACJW	ACMX	AHIM	AHKW	AHOV	AIKN	AINV	AJKW	AJOV	AKMV
ABHW	ABKN	ABNV	ACHP	ACJX	ACNO	AHIN	AHKX	AHOW	AIKO	AINW	AJKX	AJOW	AKMW
ABHX	ABKO	ABNW	ACHQ	ACKL	ACNP	AHIO	AHLM	AHOX	AIKP	AINX	AJLM	AJOX	AKMX

Marking codes for turtles:
4 scutes marked = 1,799 individual marks (continued from previous page):

AKNO	ALNO	AMOQ	ANWX	BCHP	BCKN	BCOP	BHJM	BHMQ	BIJN	BIMV	BJKP	VJOV	BKNO
AKNP	ALNP	AMOV	AOPQ	BCHQ	BCKO	BCOQ	BHJN	BHMV	BIJO	BIMW	BJKQ	BJOW	BKNP
AKNQ	ALNQ	AMOW	AOPV	BCHV	BCKP	BCOV	BHJO	BHMW	BIJP	BIMX	BJKV	BJOX	BKNQ
AKNV	ALNV	AMOX	AOPW	BCHW	BCKQ	BCOW	BHJP	BHMX	BIJQ	BINO	BJKW	BJPQ	BKNV
AKNW	ALNW	AMPQ	AOPX	BCHX	BCKV	BCOX	BHJQ	BHNO	BIJV	BINP	BJKX	BJPV	BKNW
AKNX	ALNX	AMPV	AOQV	BCIJ	BCKW	BCPQ	BHJV	BHNP	BIJW	BINQ	BJLM	BJPW	BKNX
AKOP	ALOP	AMPW	AOQW	BCIK	BCKX	BCPV	BHJW	BHNQ	BIJX	BINV	BJLN	BJPX	BKOP
AKOQ	ALOQ	AMPX	AOQX	BCIL	BCLM	BCPW	BHJX	BHNV	BIKL	BINW	BJLO	BJQV	BKOQ
AKOV	ALOV	AMQV	AOVW	BCIM	BCLN	BCPX	BHKL	BHNW	BIKM	BINX	BJLP	BJQW	BKOV
AKOW	ALOW	AMQW	AOVX	BCIN	BCLO	BCQV	BHKM	BHNX	BIKN	BIOP	BJLQ	BJQX	BKOW
AKOX	ALOX	AMQX	AOWX	BCIO	BCLP	BCQW	BHKN	BHOP	BIKO	BIOQ	BJLV	BJVW	BKOX
AKPQ	ALPQ	AMVW	APQV	BCIP	BCLQ	BCQX	BHKO	BHOQ	BIKP	BIOV	BJLW	BJVX	BKPQ
AKPV	ALPV	AMVX	APQW	BCIQ	BCLV	BCVW	BHKP	BHOV	BIKQ	BIOW	BJLX	BJWX	BKPV
AKPW	ALPW	AMWX	APQX	BCIV	BCLW	BCVX	BHKQ	BHOW	BIKV	BIOX	BJMN	BKLM	BKPW
AKPX	ALPX	ANOP	APVW	BCIW	BCLX	BCWX	BHKV	BHOX	BIKW	BIPQ	BJMO	BKLN	BKPX
AKQV	ALQV	ANOQ	APVX	BCIX	BCMN	BHIJ	BHKW	BHPQ	BIKX	BIPV	BJMP	BKLO	BKQV
AKQW	ALQW	ANOV	APWX	BCJK	BCMO	BHIK	BHKX	BHPV	BILM	BIPW	BJMQ	BKLP	BKQW
AKQX	ALQX	ANOW	AQVW	BCJL	BCMP	BHIL	BHLM	BHPW	BILN	BIPX	BJMV	BKLQ	BKQX
AKVW	ALVW	ANOX	AQVX	BCJM	BCMQ	BHIM	BHLN	BHPX	BILO	BIQV	BJMW	BKLV	BKVW
AKVX	ALWX	ANPQ	AQWX	BCJN	BCMV	BHIN	BHLO	BHQV	BILP	BIQW	BJMX	BKLW	BKVX
AKWX	ALWX	ANPV	AVWX	BCJO	BCMW	BHIO	BHLP	BHQW	BILQ	BIQX	BJNO	BKLX	BKWX
ALMN	AMNO	ANPW	BCHI	BCJP	BCMX	BHIP	BHLQ	BHQX	BILV	BIVW	BJNP	BKMN	BLMN
ALMO	AMNP	ANPX	BCHJ	BCJQ	BCNO	BHIQ	BHLV	BHVW	BILW	BIVX	BJNQ	BKMO	BLMO
ALMP	AMNQ	ANQV	BCHK	BCJV	BCNP	BHIV	BHLW	BHVX	BILX	BIWX	BJNV	BKMP	BLMP
ALMQ	AMNV	ANQW	BCHL	BCJW	BCNQ	BHIW	BHLX	BHWX	BIMN	BJKL	BJNW	BKMQ	BLMQ
ALMV	AMNW	ANQX	BCHM	BCJX	BCNV	BHIX	BHMN	BIJK	BIMO	BJKM	BJNX	BKMV	BLMV
ALMW	AMNX	ANVW	BCHN	BCKL	BCNW	BHJK	BHMO	BIJL	BIMP	BJKN	BJOP	BKMW	BLMW
ALMX	AMOP	ANVX	BCHO	BCKM	BCNX	BHJL	BHMP	BIJM	BIMQ	BJKO	BJOQ	BKMX	BLMX

Marking codes for turtles:
4 scutes marked = 1,799 individual marks (continued from previous pages):

BLNO	BNOQ	BPVX	CHKM	CHNX	CIKN	CIOP	CJLQ	CJQX	CKOW	CLOW	CMQW	CPVX	HIKV
BLNP	BNOV	BPWX	CHKN	CHOP	CIKO	CIOQ	CJLV	CJVW	CKOX	CLOX	CMQX	CPWX	HIKW
BLNQ	BNOW	BQVW	CHKO	CHOQ	CIKP	CIOV	CJLW	CJVX	CKPQ	CLPQ	CMVW	CQVW	HIKX
BLNV	BNOX	BQVX	CHKP	CHOV	CIKQ	CIOW	CJLX	CJWX	CKPV	CLPV	CMVX	CQVX	HILM
BLNW	BNPQ	BQWX	CHKQ	CHOW	CIKV	CIOX	CJMN	CKLM	CKPW	CLPW	CMWX	CQWX	HILN
BLNX	BNPV	BVWX	CHKV	CHOX	CIKW	CIPQ	CJMO	CKLN	CKPX	CLPX	CNOP	CVWX	HILO
BLOP	BNPW	CHIJ	CHKW	CHPQ	CIKX	CIPV	CJMP	CKLO	CKQV	CLQV	CNOQ	CPVX	HILP
BLOQ	BNPX	CHIK	CHKX	CHPV	CILM	CIPW	CJMQ	CKLP	CKQW	CLQW	CNOV	CPWX	HILQ
BLOV	BNQV	CHIL	CHLM	CHPW	CILN	CIPX	CJMV	CKLQ	CKQX	CLQX	CNOW	CQVW	HILV
BLOW	BNQW	CHIM	CHLN	CHPX	CILO	CIQV	CJMW	CKLV	CKVW	CLVW	CNOX	CQVX	HILW
BLOX	BNQX	CHIN	CHLO	CHQV	CILP	CIQW	CJMX	CKLW	CKVX	CLVX	CNPQ	CQWX	HILX
BLPQ	BNVW	CHIO	CHLP	CHQW	CILQ	CIQX	CJNO	CKLX	CKWX	CLWX	CNPV	CVWX	HIMN
BLPV	BNVX	CHIP	CHLQ	CHQX	CILV	CIVW	CJNP	CKMN	CLMN	CMNO	CNPW	HIJK	HIMO
BLPW	BNWX	CHIQ	CHLV	CHVW	CILW	CIVX	CJNQ	CKMO	CLMO	CMNP	CNPX	HIJL	HIMP
BLPX	BOPQ	CHIV	CJLW	CHVX	CILX	CIWX	CJNV	CKMP	CLMP	CMNQ	CNQV	HIJM	HIMQ
BLQV	BOPV	CHIW	CHLX	CHWX	CIMN	CJKL	CJNW	CKMQ	CLMQ	CMNV	CNQW	HIJN	HIMV
BLQW	BOPW	CHIX	CHMN	CIJK	CIMO	CJKM	CJNX	CKMV	CLMV	CMNW	CNQX	HIJO	HIMW
BLQX	BOPX	CHJK	CHMO	CIJL	CIMP	CJKN	CJOP	CKMW	CLMW	CMNX	CNVW	HIJP	HIMX
BLVW	BOQV	CHJL	CHMP	CIJM	CIMQ	CJKO	CJOQ	CKMX	CLMX	CMOP	CNVX	HIJQ	HINO
BLVX	BOQW	CHJM	CHMQ	CIJN	CIMV	CJKP	CJOV	CKNO	CLNO	CMOQ	CNWX	HIJV	HINP
BLWX	BOQX	CHJN	CHMV	CIJO	CIMW	CJKQ	CJOW	CKNP	CLNP	CMOV	COPQ	HIJW	HINQ
BMNO	BOVW	CHJO	CHMW	CIJP	CIMX	CJKV	CJOX	CKNQ	CLNQ	CMOW	COPV	HIJX	HINV
BMNP	BOVX	CHJP	CHMX	CIJQ	CINO	CJKW	CJPQ	CKNV	CLNV	CMOX	COPW	HIKL	HINW
BMNQ	BOWX	CHJQ	CHNO	CIJV	CINP	CJKX	CJPV	CKNW	CLNW	CMPQ	COPX	HIKM	HINX
BMNV	BPQV	CHJV	CHNP	CIJW	CINQ	CJLM	CJPW	CKNX	CLNX	CMPV	CPQV	HIKN	HIOP
BMNW	BPQW	CHJW	CHNQ	CIJX	CINV	CJLN	CJPX	CKOP	CLOP	CMPW	CPQW	HIKO	HIOQ
BMNX	BPQX	CHJX	CHNV	CIKL	CINW	CJLO	CJQV	CKOQ	CLOQ	CMPX	CPQX	HIKP	HIOV
BNOP	BPVW	CHKL	CHNW	CIKM	CINX	CJLP	CJQW	CKOV	CLOV	CMQV	CPVW	HIKQ	HIOW

Marking codes for turtles:
4 scutes marked = 1,799 individual marks (continued from previous pages):

HIOX	HJMN	HKLM	HKPW	HLPW	HMWX	HPQX	IJMQ	IKLP	IKQW	ILQW	INOV	IPWX	JKOV
HIPQ	HJMO	HKLN	HKPX	HLPX	HNOP	HPVW	IJMV	IKLQ	IKQX	ILQX	INOW	IQVW	JKOW
HIPV	HJMP	HKLO	HKQV	HLQV	HNOQ	HPVX	IJMW	IKLV	IKVW	ILVW	INOX	IQVX	JKOX
HIPW	HJMQ	HKLP	HKQW	HLQW	HNOV	HPWX	IJMX	IKLW	IKVX	ILVX	INPQ	IQWX	JKPQ
HIPX	HJMV	HKLQ	HKQX	HLQX	HNOW	HQVW	IJNO	IKLX	IKWX	ILWX	INPV	IVWX	JKPV
HIQV	HJMW	HKLV	HKVW	HLVW	HNOX	HQVX	IJNP	IKMN	ILMN	IMNO	INPW	JKLM	JKPW
HIQW	HJMX	HKLW	HKVX	HLVX	HNPQ	HQWX	IJNQ	IKMO	ILMO	IMNP	INPX	JKLN	JKPX
HIQX	HJNO	HKLX	HKWX	HLWX	HNPV	HVWX	IJNV	IKMP	ILMP	IMNQ	INQV	JKLO	JKQV
HIVW	HJNP	HKMN	HLMN	HMNO	HNPW	IJKL	IJNW	IKMQ	ILMQ	IMNV	INQW	JKLP	JKQW
HIVX	HJNQ	HKMO	HLMO	HMNP	HNPX	IJKM	IJNX	IKMV	ILMV	IMNW	INQX	JKLQ	JKQX
HIWX	HJNV	HKMP	HLMP	HMNQ	HNQV	IJKN	IJOP	IKMW	ILMW	IMNX	INVW	JKLV	JKVW
HJKL	HJNW	HKMQ	HLMQ	HMNV	HNQW	IJKO	IJOQ	IKMX	ILMX	IMOP	INVX	JKLW	JKVX
HJKM	HJNX	HKMV	HLMV	HMNW	HNQX	IJKP	IJOV	IKNO	ILNO	IMOQ	INWX	JKLX	JKWX
HJKN	HJOP	HKMW	HLMW	HMNX	HNVW	IJKQ	IJOW	IKNP	ILNP	IMOV	IOPQ	JKMN	JLMN
HJKO	HJOQ	HKMX	HLMX	HMOP	HNVX	IJKV	IJOX	IKNQ	ILNQ	IMOW	IOPV	JKMO	JLMO
HJKP	HJOV	HKNO	HLNO	HMOQ	HNWX	IJKW	IJPQ	IKNV	ILNV	IMOX	IOPW	JKMP	JLMP
HJKQ	HJOW	HKNP	HLNP	HMOV	HOPQ	IJKX	IJPV	IKNW	ILNW	IMPQ	IOPX	JKMQ	JLMQ
HJKV	HJOX	HKNQ	HLNQ	HMOW	HOPV	IJLM	IJPW	IKNX	ILNX	IMPV	IOQV	JKMV	JLMV
HJKW	HJPQ	HKNV	HLNV	HMOX	HOPW	IJLN	IJPX	IKOP	ILOP	IMPW	IOQW	JKMW	JLMW
HJKX	HJPV	HKNW	HLNW	HMPQ	HOPX	IJLO	IJQV	IKOQ	ILOQ	IMPX	IOQX	JKMX	JLMX
HJLM	HJPW	HKNX	HLNX	HMPV	HOQV	IJLP	IJQW	IKOV	ILOV	IMQV	IOVW	JKNO	JLNO
HJLN	HJPX	HKOP	HLOP	HMPW	HOQW	IJLQ	IJQX	IKOW	ILOW	IMQW	IOVX	JKNP	JLNP
HJLO	HJQV	HKOQ	HLOQ	HMPX	HOQX	IJLV	IJVW	IKOX	ILOX	IMQX	IOWX	JKNQ	JLNQ
HJLP	HJQW	HKOV	HLOV	HMQV	HOVW	IJLW	IJVX	IKPQ	ILPQ	IMVW	IPQV	JKNV	JLNV
HJLQ	HJQX	HKOW	HLOW	HMQW	HOVX	IJLX	IJWX	IKPV	ILPV	IMVX	IPQW	JKNW	JLNW
HJLV	HJVW	HKOX	HLOX	HMQX	HOWX	IJMN	IKLM	IKPW	ILPW	IMWX	IPQX	JKNX	JLNX
HJLW	HJVX	HKPQ	HLPQ	HMVW	HPQV	IJMO	IKLN	IKPX	ILPX	INOP	IPVW	JKOP	JLOP
HJLX	HJWX	HKPV	HLPV	HMVX	HPQW	IJMP	IKLO	IKQV	ILQV	INOQ	IPVX	JKOQ	JLOQ

Marking codes for turtles:

4 scutes marked = 1,799 individual marks (continued from previous pages):

JLOV	JMQV	JOVW	KLOV	KMQV	KOVW	LMQV	LOVW	MOPQ	NOVX
JLOW	JMQW	JOVX	KLOW	KMQW	KOVX	LMQW	LOVX	MOPV	NOWX
JLOX	JMQX	JOWX	KLOX	KMQX	KOWX	LMQX	LOWX	MOPW	NPQV
JLPQ	JMVW	JPQV	KLPQ	KMVW	KPQV	LMVW	LPQV	MOPX	NPQW
JLPV	JMVX	JPQW	KLPV	KMVX	KPQW	LMVX	LPQW	MOQV	NPQX
JLPW	JMWX	JPQX	KLPW	KMWX	KPQX	LMWX	LPQX	MOQW	NPVW
JLPX	JNOP	JPVW	KLPX	KNOP	KPVW	LNOP	LPVW	MOQX	NPVX
JLQV	JNOQ	JPVX	KLQV	KNOQ	KPVX	LNOQ	LPVX	MOVW	NPWX
JLQW	JNOV	JPWX	KLQW	KNOV	KPWX	LNOV	LPWX	MOVX	NQVW
JLQX	JNOW	JQVW	KLQX	KNOW	KQVW	LNOW	LQVW	MOWX	NQVX
JLVW	JNOX	JQVX	KLVW	KNOX	KQVX	LNOX	LQVX	MPQV	NQWX
JLVX	JNPQ	JQWX	KLVX	KNPQ	KQWX	LNPQ	LQWX	MPQW	NVWX
JLWX	JNPV	JVWX	KLWX	KNPV	KVWX	LNPV	LVWX	MPQX	OPQV
JMNO	JNPW	KLMN	KMNO	KNPW	LMNO	LNPW	MNOP	MPVW	OPQW
JMNP	JNPX	KLMO	KMNP	KNPX	LMNP	LNPX	MNOQ	MPVX	OPQX
JMNQ	JNQV	KLMP	KMNQ	KNQV	LMNQ	LNQV	MNOV	MPWX	OPVW
JMNV	JNQW	KLMQ	KMNV	KNQW	LMNV	LNQW	MNOW	MQVW	OPVX
JMNW	JNQX	KLMV	KMNW	KNQX	LMNW	LNQX	MNOX	MQVX	OPWX
JMNX	JNVW	KLMW	KMNX	KNVW	LMNX	LNVW	MNPQ	MQWX	OQVW
JMOP	JNVX	KLMX	KMOP	KNVX	LMOP	LNVX	MNPV	MVWX	OQVX
JMOQ	JNWX	KLNO	KMOQ	KNWX	LMOQ	LNWX	MNPW	NOPQ	OQWX
JMOV	JOPQ	KLNP	KMOV	KOPQ	LMOV	LOPQ	MNPX	NOPV	OVWX
JMOW	JOPV	KLNQ	KMOW	KOPV	LMOW	LOPV	MNQV	NOPW	PQVW
JMOX	JOPW	KLNV	KMOX	KOPW	LMOX	LOPW	MNQW	NOPX	PQVX
JMPQ	JOPX	KLNW	KMPQ	KOPX	LMPQ	LOPX	MNQX	NOQV	PQWX
JMPV	JOQV	KLNX	KMPV	KOQV	LMPV	LOQV	MNVW	NOQW	PVWX
JMPW	JOQW	KLOP	KMPW	KOQW	LMPW	LOQW	MNVX	NOQX	QVWX
JMPX	JOQX	KLOQ	KMPX	KOQX	LMPX	LOQX	MNWX	NOVW	

HERPETOFAUNA PHOTO VOUCHERING

The following is adapted from a chapter in the forthcoming PARC herpetofauna Inventory and Monitoring Techniques book, edited by Gabrielle Grater and Kurt Buhlmann of the Savanna River Ecology Lab. The photo vouchering chapter was compiled by John Jensen with the Georgia Department of Natural Resources.

The purpose of photo vouchering is to provide evidence that a species occurs in a given area. This is necessary to ensure confidence in reported records and to ensure that the sightings are accurate. For some species, photo records may not be adequate for vouchers. In these situations, a voucher specimen may be needed. Iowa's amphibians are distinct enough from each other that they can be voucher with high quality photography, with one exception. The gray tree frogs (*Hula vesicular* and *H. chrysoscelis*) can only be distinguished by DNA chromosomal analysis or by the sound of their calls with *H.* chrysoscelis having a call with a higher pitch. It is recommended that if vouchering of these species in needed, a recording be made of their calls. It should be possible to document all of Iowa's reptiles with photographs if the objective is only to document the occurrence of a species at a given site.

DEFINITIONS:
Anal plate – The wide scale anterior to the anus.
Dorsal – Of or involving the back.
Dorsolateral – Of or involving both the back and the side.
Keeled – A ridge down the center of the scale, resulting in a rough or dull appearance.
Lateral – Of or involving the side.
Ventral – Of or involving the abdomen.

BASIC GUIDELINES:

1. Include a scale in the photo (or at least some of the photos of the same individual) such as a ruler, coin, pencil, or human hand.
2. Photograph animal as soon after capture as possible – some amphibians can change color when placed into containers.
3. It may be easier or necessary to place a frog or salamander into a Ziploc baggie. This will help immobilize the animal. The photo can be made through the clear plastic of the baggie. Be sure to include a small amount of water in the baggie so the amphibian does not desiccate and do NOT leave the animal in the baggie for more than a few minutes at most.

A whole body shot should be taken of each individual to be photo vouchered. This first, standard photo should be at a dorsal angle (looking at the back of the individual). In addition to this photo, several additional photos will be needed depending on the species. Most field guides describe the characteristics that will be seen (or absent) from each of the photo angles. If the field guide lists a defining characteristic that is not accounted for in the lists for each group of animals below, please also photograph the presence or absence of that characteristic.

SALAMANDERS:

For the 5 salamander species which occur in Iowa, all should have an additional photo taken which clearly shows the whole body from a dorsolateral angle. For 4 of the 5 species, clear, high definition photos from those 2 angles should be sufficient for identification. The mudpuppy (*Necturus maculosus*), however, should also have the belly photographed.

ANURANS:

Frogs

The following list of 6 additional photos should be taken to voucher the *Rana* species listed by the photo angle. *Rana* of unknown species or those found outside of their known range should have photos taken from all of the following angles:

1. Dorsal showing the full extent of the dorsolateral ridges (*R. blairi, R. pipiens, R. utricularia*)
2. Dorsolateral (All *Rana* species)
3. Head – dorsal (*R. catesbeiana*)
4. Head – lateral (*R. pipiens, R. sphenocephala*)
5. Toe webbing (*R. catesbeiana, R. clamitans*)
6. Ventral or belly (*R. palustris*)

*Suspected wood frogs (*R. sylvatica*) should have all of the above photos taken.

Treefrogs

The following list of additional photos should be taken to voucher treefrog species listed by each angle. Treefrog species have toe-pads. If you are unsure of which treefrog species is in hand, please take photos of all the following angles:

1. Back of thigh (*Acris crepitans, Hyla chrysoscelis, H. versicolor)*
2. Dorsolateral (*H. chrysoscelis, H. versicolor, Pseudacris crucifer, P. triseriata*)
3. Head – dorsal (*A. crepitans*)
4. Toe webbing (*A. crepitans*)

*Remember that the only way to distinguish between *H. chrysoscelis* and *H. versicolor* in the field is by the sound of their calls. If it is necessary to voucher these species from a particular site, a recording of their calls must be made.

Toads

The following list of additional photos should be taken for each of Iowa's 4 toad species in order to voucher the species presence for a given site.

1. Head – dorsal
2. Dorsolateral
3. Number of warts occurring per spot (the photo should be a close-up of several spots where the number of warts can be clearly counted)
4. Ventral

Spadefoot toad

There is only one species of spadefoot toad known to occur in Iowa. In addition to the lateral photo for this species, additional photos showing the eyes and/or the spade on the back foot would clearly voucher this species.

SNAKES:

Nonvenomous Snakes

For all nonvenomous snakes, a dorsolateral photo should be taken in addition to that of the lateral angle. It is also suggested to photograph both the ventral side and the anal plate of many of the species in Iowa. These 4 photos should be sufficient to document the majority of the nonvenomous species with a few exceptions:

1. Additional dorsolateral photo, close enough to be able to count the rows of scales with striping above the ventral scales (*Thamnophis* sp.)
2. Head – dorsal (*Virginia valeriae*)
3. Head – lateral (*Heterodon* sp.)
4. Photograph showing the keeled or lack of keeled scales (*Opheodrys aestivus* & *O. vernalis*)

Venomous Snakes

It is not recommended to handle a venomous snake without the proper training on the appropriate handling techniques. Take the best photo possible without endangering yourself. The dorsal pattern on Iowa's 4 venomous snakes is distinct enough to allow identification. This picture can be taken without touching the animal. Remember to keep an appropriate distance from the snake at all times.

LIZARDS:

Iowa has 5 lizards. Photographs of the dorsolateral angle should be taken of each of them in addition to the dorsal photo. In addition, the slender glass lizard (*Ophisaurus attenuatus*) should be photographed from the lateral angle, and the 3 skink species (*Eumeces fasciatus, E. obsoletus, and E. septentrionalis*) should be documented from the lateral side of the head, specifically focusing on the ear area, and the lateral side of the tail.

TURTLES:

All of Iowa's turtles should have photographs of the dorsolateral side and the ventral side (also known as the plastron in turtles) taken in addition to the dorsal photograph. Other suggested photos include:

1. Head – dorsal (*Graptemys geographica*, & *G. pseudogeographica*)
2. Head – lateral (*Clemmys insculpta, Emydoidea blandingi, Kinosternon flavescens, Sternotherus odoratus*, & *Trachemys scripta*)
3. Leading (neck) edge of carapace (*Apalone mutica* & *A. spinifera*)
4. Nostrils (*A. mutica* & *A. spinifera*)