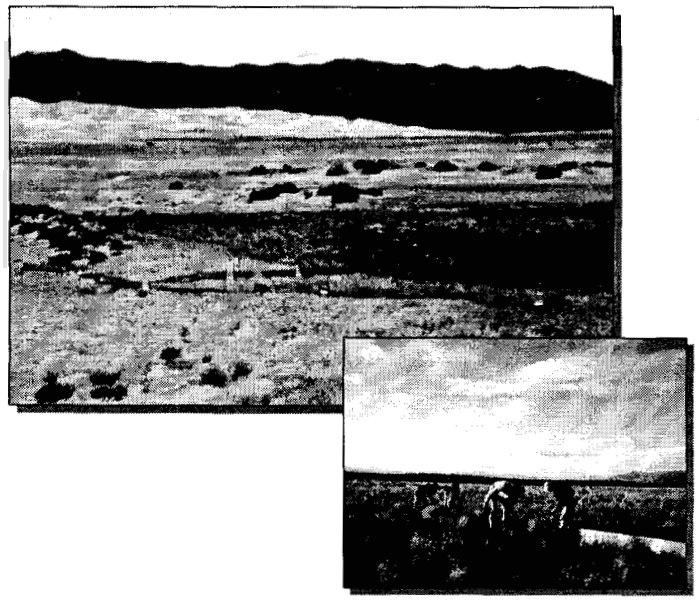
Report to Great Sand Dunes National Monument and Preserve

NPS Inventory and Monitoring Project – Amphibians and Reptiles
In cooperation with DOI Amphibian Research and Monitoring Initiative

Final Report
1 November 2002



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(photos by S. Street & E. Muths)

Background

Great Sand Dunes National Monument and Preserve (GRSA) is located at the base of the Sangre de Cristo mountains in southern Colorado approximately 56 km NE of Alamosa. This protected area includes the tallest sand dunes in North America and is home to the tiger beetle (*Cicindela theatina*), a species endemic to the Great Sand Dunes ecoregion. Within the Monument and Preserve there are 39 square miles of dunes, subalpine habitats including spruce-pine forests, grassland and wetland areas, and alpine terrain including high elevation lakes and tundra. To date there have been no systematic amphibian surveys focused on both the Monument and the Preserve at Great Sand Dunes. The Medano Zapata Ranch (MZR) is a property of The Nature Conservancy (TNC) immediately adjacent to GRSA that shares the same landforms and springs.

There is information about resident amphibians from a variety of sources such as incidental reports by TNC, personal communication from local herpetologist,; and Hahn (1968). We surveyed Great Sand Dunes National Monument and Preserve as part of the National Park Service's Inventory and Monitoring Program and in cooperation with the DOI Amphibian Research and Monitoring Initiative (ARMI). Two sites on the MZR were included in these surveys because of their proximity to the dunes (in the context of this report, GRSA will refer to the Monument and Preserve areas and the two sites on TNC property).

The ARMI program and the I & M programs have parallel, but unique goals. The Amphibian Research and Monitoring Initiative uses a 3-tiered approach including broad-scale surveys and sentinel site research. Our work at GRSA fell under the broad scale survey tier of ARMI. The goal of the Park Service's I & M program is to document, with voucher specimens, 90% of the amphibian and reptile species occurring at GRSA. While we can project what species we expect to be at GRSA from range maps, published and unpublished accounts, our goal is to document 90% of what is actually there rather than 90% of what the sources list as present. This is a fine distinction, but an important one. For example, if we were working to find 90% of what is listed to be at

a location, and we found everything in 3 weeks, the project would be over. Working under the alternative paradigm of finding 90% of what is present, we would survey until the unit effort was yielding no new species. As a starting point, we consulted Hammerson (1999), Hahn (1968), and local herpetologists (Drs. Tim Armstrong and Hobart Dixon, Adams State College, Alamosa). Hammerson (1999) reports 5 amphibian species from Great Sand Dunes National Monument; (tiger salamander [*Ambystoma tigrinum*], chorus frog [*Pseudacris triseriata*], Plains spadefoot toad [*Spea bombifrons*], Great Plains toad [*Bufo cognatus*], Woodhouse's toad [*Bufo woodhousii*]) and 7 reptile species (prairie and plateau lizards = eastern fence lizard [*Sceloporus undulatus*], variable skink [*Eumeces gaigeae*], short-horned lizard [*Phrynosoma hernandesi*], milk snake [*Lampropeltis triangulum*], bull snake [*Pituophis catenifer*], western terrestrial garter snake [*Thamnophis elegans*], and western rattlesnake [*Crotalus viridis*]).

Our goal was two-fold, 1) to provide a systematic, broad-scale survey of GRSA and 2) to document 90% of the amphibian and reptile species present. In 2001 we focused on the broad-scale survey. In 2002 we focused on specific likely habitats using VES and pitfall trap arrays.

Methods

Site Selection

In preparation for the cell surveys, a 1000 m x 1000 m grid was overlaid on an existing GRSA map. All or portions of 674 cells fell within GRSA. We randomly selected cells in the Monument (n = 148) and in the Preserve (n = 71). Of the selected cells in the Monument, 29 were eliminated because of their location in the dune field.

In 2002 we shifted emphasis from broad-scale surveys to a habitat specific approach. We constructed 6 pitfall arrays at selected locations chosen based on accessibility and habitat characteristics. We chose habitats likely to harbor amphibians and reptiles and to be representative of the habitat diversity at GRSA. Input from Fred Bunch (GRSA), and Drs. Tim Armstrong and Hobart Dixon (Adams State College) assisted in the selection process. We also conducted visual encounter surveys at 13

sites that were selected by presence or proximity to water and / or wetland area. Most sites were in close association with Medano Creek.

Visual Encounter Surveys

Cells were surveyed using visual encounter surveys in the order they were selected where logistically possible. Two to 4 technicians located the northwest corner of each cell (using Garmin Etrex GPS units), then walked transects across the cell. Transects were approximately 25 m apart and walked north to south.

Visual encounter surveys (Heyer et al. 1994) were used throughout the project to search for all life stages of amphibians (egg, larva, and adult) and for adult reptiles. We focused on habitat where we were likely to encounter amphibians or reptiles during the surveys. Dip nets were used to sample areas with limited visibility and likely shallows with emergent vegetation were examined meticulously for eggs and larvae. Wetland areas, boulders, rocky outcrops, and downed woody debris received special attention. Dense forests received less attention, but likely habitat within these areas, such as woodpiles or rocky debris, was searched. Although we focused on habitat where we were likely to encounter amphibians or reptiles, the entire cell was surveyed. Habitat characteristics were recorded for each cell. For each animal captured, mass and snout-vent length were determined, and animals were released at the capture site or kept as voucher specimens. Voucher specimens are being housed at USGS-FORT, Fort Collins, CO until direction is received from the National Park Service on where the vouchers will be housed permanently.

Pitfall Trapping

We constructed one-armed pitfall arrays (Heyer et al. 1994, Fig. 1) at 3 locations at GRSA (Fig. 2) on a trial basis in 2001: Sand Sheet, Denton Springs, and Hawthorne. The Sand Sheet pitfall array was located at the southern edge of the Monument on the sand sheet. Vegetation is sparse (approximately 10-20% cover) with a few grasses and shrubs present depending on sand movement. The Denton Springs pitfall array is east of County Road 150 on the Monument. The array is in rocky upland habitat vegetated

with pinyon-juniper, sparse shrubs, and grasses (approximately 0-5 % ground cover). The Hawthorne array is approximately 1.5 km from the "Point of No Return" on the Medano Pass 4WD road, near the Medano Creek Gauging Station. This array is in an open, grassy meadow near a grouping of Hawthorne shrubs between Medano Creek and the Sand Creek nature trail (approximately 10-20 % ground cover).

In the fall of 2001 we completed the 3 trial arrays, adding 2 arms to each for a total of 3 arms and 10 buckets per array. We also selected 3 more sites and set up arrays (Fig. 1). The East Elk Pond array was in riparian habitat near a natural spring that forms a pond that remains wet most of the year (the water table is very close to the surface at this location). It is in the northwestern portion of GRSA on the border between the Monument and MZR. East Elk Pond is approximately 6 km from the MZR headquarters. The Indian (Big) Spring and Little Spring pitfall arrays were on TNC property. Archeological research is ongoing at these sites. We consulted with Medano Zapata Ranch staff to determine locations that were least likely to disturb archeological artifacts (Mike Gibson, pers. comm.). Indian Spring is a natural spring near the border of the Monument. This array was placed in the upland ecotone between riparian habitat and dune field. Scrubby shrubs and grass were more abundant at Indian Spring than at Little Spring or East Elk Pond (approximately 60% cover). Little Spring is also a natural spring. This array was located in the lowland ecotone between riparian habitat and dune field. Wetland vegetation (e.g., sedges) and sparse shrubs provided cover in the area of the array (approximately 30-40 %). The Denton Springs and Hawthorne pitfall trap arrays were not removed at the end of the study as per direction by GRSA (F. Bunch, pers. com.).

We used 5 gallon buckets for traps spaced approximately 5-7 m apart. Metal flashing screwed to stakes was used to intercept amphibians and reptiles moving along the surface and redirect them into buckets. Buckets were covered with lids fitted with 2-inch wooden legs. The legs allowed access to the buckets while shading them at the same time. Traps were opened in the evening and checked between 0640 and 1230 hrs each day of the session. Trap nights were counted as: (number of arrays x number of buckets x number of nights traps are open) (Corn 1994). For example, in 2002, we had

([5 arrays x 10 buckets x 25 nights] + [1 array x 10 buckets x 21 nights]) = 1460 trap nights. In 2001 pitfall arrays were opened during 3 sessions from mid May to early August. A session included 3-6 consecutive nights of trapping at each array (Table 3). In 2002, pitfall arrays were opened during 4 sessions from mid May to early July (Table 3). A session included 4-9 consecutive nights of trapping at each array. Captured amphibians and reptiles were identified to species, mass and snout-vent length determined, and either released at site of capture or kept as voucher specimens. Non-target animals (mammals) were not measured or examined closely and released at site of capture (Table 2).

Voucher collection

Specimens were collected to provide vouchers for the NPS Inventory and Monitoring Program and as part of the Amphibian Research and Monitoring Initiative. Information collected on each voucher included: date and time of collection, location at capture (UTMs), weather conditions, species, snout-vent length (SVL), mass, sex, coloration, behavior, date of preservation, and collector's name. Euthanasia and preparation of voucher specimens followed standard protocol (Heyer et al.1994 and National Wildlife Health Laboratory and ARMI standard operating procedures; see the following websites: http://www.nwhc.usgs.gov/research/amph_dc/sop_anesth.html, http://www.nwhc.usgs.gov/research/amph_dc/sop_restraint.html). Adult specimens are stored in 70% ETOH, and egg and larval specimens are stored in 10% formalin (Gotte and Reynolds 1997). All specimens are currently housed at FORT until a final location is selected.

Results

Visual Encounter Surveys – Cell Surveys 2001

Between 17 May and 3 August 2001, 4 species of amphibian (*A. tigrinum, S. bombifrons, B. woodhousii,* and *B. cognatus*) and 5 species of reptile (*P. hernandesi, S. undulatus, E. gaigeae, P. catenifer*, and *T. elegans*) were detected. This represents

80% (4 of 5 species) of the amphibians and 71% (5 of 7 species) of the reptiles predicted to be in this area by Hammerson (1999). Of the 43 cells that were surveyed, we found amphibians and / or reptiles in 11 (287, 328, 329, 330, 332, 333, 370, 624, 711, 754, 840) (See report to GRSA [Muths, 2001]). In addition to the cells, we conducted VES at 4 selected sites, Indian Spring, Little Spring, Elk Ponds, Interdunal breeding pond (INBP) and Spadefoot toad pond (SPFO) (Fig. 1). We spent a total of 250.1 person hours surveying 43 cells (226.5 hrs) and 4 sites (23.6 hrs). 41 cells were visited once, 2 cells and 2 sites were visited 2 times, and 2 sites were visited 3 times (Table 2).

Visual Encounter Surveys – Selected Habitats 2002

Wandering garter snakes (*T. elegans*), Woodhouse's toads (*B. woodhousii*) and tiger salamanders (*A. tigrinum*) were found during 67 hours of VES between 29 May and 12 July. We searched 11 sites along or adjacent to Medano Creek, and 2 sites at East Elk Pond and Little Spring. Each of these sites was visited once. Sites associated with Medano Creek included slow moving water associated with beaver ponds or areas that had held water recently. Silt or mud substrates dominated, with grasses, sedges, willows, and alders the most common vegetation. Native trout species were present at all sites surveyed. The following narratives describe the area of the VES and the amphibians and reptiles detected (Table1B).

Little Spring

Little Spring is located in the middle of a dune area. This site had about 30% emergent vegetation, mainly sedges, located primarily on the north shore. It had a sandy substrate and was used heavily by wildlife including bison, waterfowl, small mammals, deer, and elk. We detected only *Bufo woodhousii*. The weather was partly cloudy with a light wind.

West Elk Pond

The water dropped drastically over the course of the summer at West Elk Pond. The water line was well below what would have been emergent vegetation in less dry years. In spite of dry conditions, about 40% of the perimeter of the pond had patchy emergent vegetation (grasses and sedges). The entire perimeter included shallows with a substrate of silt and mud. *B. woodhousii* and *A. tigrinum* were detected. The weather was partly cloudy with a light wind.

Medano Creek Start Point

In the area of the survey, the creek was 1-2 m wide and less than 1 m deep with rocks and cobble substrate. Willows and alders shaded the survey area. No amphibians or reptiles were detected. The weather during the survey was clear and calm.

Medano Creek bed

At the survey area the creek was 1-2 m wide and < 1 m deep, the substrate was rocks and cobble. Willows and alders shaded the site. One garter snake was found, but no amphibians were detected. The weather was clear and calm.

Deserted Beaver Pond

This pond is surrounded by willow forest, was < 1 m deep, and appeared to be an abandoned beaver pond. It had 100% shallows around the perimeter with 3% in emergent vegetation (mainly grass). Fish were present. No amphibians or reptiles were detected. The weather was partly cloudy with a light wind.

Deserted Beaver Pond 2

This site is a deserted beaver pond (<1 meter deep) that looked like a flood had washed out the dam. There was no emergent vegetation, but there were sedges at the perimeter and dead willows were evident in the pond. The substrate was silt and mud. No amphibians or reptiles were detected. The weather during the survey was partly cloudy with a light wind.

Active Beaver Pond 1

This pond is <1 m deep and surrounded by willow forest. It has 10% emergent vegetation (mostly grass) around the perimeter. No amphibians or reptiles were detected. The weather during the survey was partly cloudy with a light wind.

Active Beaver Pond 2

This 1-2 m deep pond is surrounded by willow forest. It had 100% shallows around the perimeter and 5% emergent vegetation (mostly grass). No amphibians or reptiles were detected. The weather was overcast with a light wind.

Active Beaver Pond 3

This beaver pond is < 1 m deep and was about 5 x 50 m with 100% shallows around the perimeter and 90% emergent vegetation (mainly grass). The substrate was silt and mud, and fish were present. No amphibians were detected, but 3 garter snakes were found. The weather during the survey was clear and calm.

Active Beaver Complex

This site is comprised of 3 ponds surrounded by willows and alders. Shallows were present around the entire perimeter of each pond. Approximately 5% of the ponds had emergent vegetation (mainly grass). No amphibians or reptiles were detected. The weather was overcast with a light wind.

Beaver Complex 1

This complex consisted of 2 ponds (maximum depth 2 m) located in the midst of a pine-willow forest. Emergent vegetation was primarily grass and fish were present. No amphibians were detected, but 2 garter snakes were found. The weather was clear and calm.

Beaver Complex 2

This complex consisted of 5 ponds (maximum depth 2 m). Shallows were present on the north shore, but only 5% of the complex had emergent vegetation (mainly grass). No amphibians were detected, but 2 garter snakes were found. Fish were present at the time of the survey, and the weather was partly cloudy and calm.

Point 1 – Medano Creek

This point is on the east side of a slow-moving stream about 2 m wide and < 1 m deep. There was no emergent vegetation. The surrounding vegetation was grass and willows. No amphibians or reptiles were detected. The weather was clear and calm.

Point 2 – Medano Creek

This point is on the North side of a slow moving stream 2 m wide and < 1 m deep. There was no emergent vegetation. Surrounding vegetation was grass and willows. One garter snake was found but no amphibians were detected. The weather was clear and calm.

Pitfall Trapping

Data for 2001 have been re-assessed; results reported in 2001 for pitfall trapping should be discounted. A total of 156 trap nights yielded one species of amphibian (*S. bombifrons*) 1 species of reptile (*S. undulatus*) and 2 mammal species (Fig. 3A). Mortality (drowning) included 4 *S. bombifrons* (collected as voucher specimens) and 1 juvenile chipmunk (Fig. 3B). Existing drain holes in the buckets were enlarged and additional holes drilled. No other mortalities by drowning occurred.

Pitfall trapping was the primary focus in 2002. One thousand four hundred and sixty trap nights yielded 2 amphibian species (*B. woodhousii, A. tigrinum*) and 2 reptiles (*P. catenifer*, and *S. undulatus* (Fig. 4A). *S. bombifrons* was the only amphibian species caught in 2001 but not in 2002. Mortality (probably exposure to cold temperatures and predation) included 10 mammals and 9 amphibians.

At least 6 mammal species ("mice" and shrews were not identified to species) including voles (likely *Microtus longicaudus*), grasshopper mice (*Onychomys leucogaster*), kangaroo rats (likely *Dipodomys ordii*), pocket gophers (likely *Thonomys talpoides*), shrews (*Sorex* spp.) and 2 or more additional species of mouse (likely *Peromyscus* spp.) (Table 2C) were captured in 2001. More mammal species were caught in 2002 than 2001.

Voucher collection

Voucher specimens were collected to provide evidence of species occurrence at GRSA (Table 4). Specimens were killed humanely (see original study plan), preserved in formalin and then transferred to 70% ethanol (Heyer et al. 1994).

Discussion and Recommendations for future work

We documented 4 amphibian species present at GRSA. The only predicted amphibian that was not present was the chorus frog (*P. triseriata*). However, chorus frogs were heard at MZR in May of 2001 (EM, pers. obs.). We documented 6 species of reptile at GRSA from our survey work, incidental captures, and reported sightings (report by tourist [with photo verification] at GRSA, F. Bunch, pers. comm.). The only predicted reptile that was not located was the milk snake (*L. triangulum*). Based on the number of person hours in the field and the variety of methods used, our data (Fig. 3 and 4) suggest that we captured the animals that were available to be captured by these methods during these 2 seasons. *S. bombifrons* and *B. cognatus* were entirely absent in 2002. Spadefoot toads are commonly believed to be almost totally fossorial, but often forage on the surface (Zug et al. 2001). However, breeding is generally associated with heavy rainfall events (Zug et al. 2001). During our surveys in 2002, only one significant rainfall event occurred (19 May); surveys immediately after this event yielded no toads. Both 2001 and 2002 were extraordinarily dry years (see USGS drought data http://co.water.usgs.gov/drought/index.html).

We used methods specifically for amphibians and reptiles that have been proven by numerous studies in a variety of habitats including habitats similar to those at GRSA

(Heyer et al. 1994, Stokes et al. in review, ftp://ftp.cbi.usgs.gov/incoming/SDFS/MAINTEXT.pdf). We caught a number of mammals in the pitfall traps. Our field crews were not trained in mammal identification nor were they prepared to deal with potential Hanta virus exposure. Field crews did not have access to appropriate training, respirators, or other recommended precautions used when dealing with potential viral infections from mammals. Therefore, mammals (primarily rodents) were examined cursorily (if at all) and released. Salvage specimens were not kept because we did not anticipate the need and therefore did not have the appropriate permits.

Because of the non-typical nature of the weather in 2001 and 2002, management decisions based on these survey data should be made with caution. Although this survey was meant to provide a baseline for the NPS Inventory and Monitoring Program, the weather during our surveys was not "typical." For baseline data to be representative of the average, data should be collected over a number of years encompassing a wide variety of weather patterns. We provide an appendix including other recent documented and anecdotal sightings of amphibians and reptiles in and around GRSA. Further work on amphibians and reptiles should include surveys of appropriate habitat during "normal" or "wet" years to combine with the data presented here to provide a more complete picture of what species are present GRSA. This study provides information for Great Sand Dunes National Monument and Preserve and two sites at MZR. However, the GRSA area was not surveyed entirely and, with the addition of the Baca Ranch, and changes in boundaries as the Monument becomes a National Park, the amount of unsurveyed habitat, potentially used by amphibians and reptiles, will increase dramatically (an increase of approximately 263 km^2, F. Bunch, pers. comm.). We suggest surveys in the newly acquired areas of the Park. These should be designed to provide spatial coverage and stratified to focus on likely amphibian and reptile habitats. To be the most useful, subsequent surveys should follow Amphibian Research and Monitoring Initiative (ARMI) protocols and provide multiple visit data suitable for analysis using proportion of area occupied (PAO) software (http://www.proteus.co.nz/). In addition to surveys, a more focused, long-term project on one or two species would be

useful. Long-term data are not common for herpetological species and would be useful to GRSA as well as to the broader herpetological research community. *B. woodhousii* is a relatively common species that was detected during both years of this survey. This species is a good candidate for intensive studies at GRSA because it is relatively abundant and was present in putatively difficult times. This is a good choice for a sentinel species for GRSA because of its "commonness". If declines in populations of this animal are detected, other amphibians could be in equal or elevated peril. Green (1997) describes a decline as:

> ...the condition whereby the local loss of populations across the normal range of a species so exceeds the rate at which populations may be established, or reestablished, that there is a definite downward trend in population number.

It is important to distinguish between a decline in numbers in a single population versus a decline in the number of populations across a landscape. For example, declines in numbers of *B. woodhousii* at East Elk Pond at GRSA may not be cause for alarm. However, declines in all the *B. woodhousii* populations across GRSA and MZR might indicate a problem. Therefore, while monitoring an individual population may be interesting in terms of breeding phenology and the behavior of that particular population, it will probably not provide good inferential data on the status of amphibians across GRSA.

A thorough design, that would allow inference up to the level of the Monument would include several discreet populations of the same species that were monitored intensively (e.g.,for 5 or more capture – recapture sessions each year during the breeding season). Specific questions should be identified before the protocol is designed. If survival estimates are one of the identified goals, at least 3 years of data are needed to estimate one survival rate (Lebreton et al. 1992). If questions about recruitment, mortality, and population size are pertinent, the number of capture sessions and amount of effort can be tailored to address these issues. Ideally, each of the selected populations would be monitored on the same dates, allowing for inter-population comparisons of capture probability. In general, the robust design (Kendall

and Pollock 1992) would provide the most flexibility in data analysis and allow estimation of population size between sampling periods, survival rates and number of new individuals entering the population between sampling periods (Pollock et al. 1990). The robust design is advantageous because it minimizes the influence of unequal catchability on estimates of demographic parameters such as recruitment. Catchability can be an important consideration and can be influenced by weather, drought, and researcher adeptness among others. By using closed population models to examine data collected within a breeding season and open models to estimate survival between breeding seasons (years) (Pollock et al. 1990), the robust design offers advantages over other methods such as the Cormack Jolly Seber model, which is based on the assumption of equal catchability (Pollock et al. 1990).

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Table 1: A. VES 2001

UTM NAD 27 zone 13

Location (cell)	Easting	Northing	Date	no. of visits	Search time (min.)	Amphibians	Reptiles
246	455850	4173880	3-Jun	1	300	--	--
286	453850	4174880	11-Jul	1	240	--	--
287	454850	4174880	24-Jul	1	450	--	*THEL (n=1)*
327	452850	4175880	13-Jun	1	360	--	--
328	453850	4175880	13-Jun	1	240	*BUWO (n=3); AMTI (n=1)*	--
329	454850	4175880	24-Jun	1	360	--	*THEL (n=1)*
332	458850	4175880	12-Jul	1	180	--	*THEL (n=2)*
333	453850	4176880	12-Jul	1	400	--	*THEL (n=3)*
370	455850	4176880	13 Jun; 22 Jul	2	360	--	*THEL (n=1)*
372	456850	4176880	23-Jul	1	360	--	--
373	454850	4177880	15-Jun	1	540	--	--
413	456850	4177880	24-Jul	1	300	--	--
415	451850	4178880	15 Jun; 11 Jul	2	690	--	--
452	452850	4178880	23-Jul	11	240	--	--
453	453850	4178880	23-Jul	1	240	--	--
454	455850	4178880	23-Jul	1	240	--	--
456	455850	4182880	24-Jun	1	300	--	--
624	453850	4174880	10-Jul	1	532	--	*THEL (n=1)*
668	458850	4183880	2-Jun	1	420	--	--
669	459850	4183880	25-Jul	1	240	--	--
670	456850	4184880	25-Jul	1	180	--	--
709	458850	4184880	1-Aug	1	180	--	--
711	459850	4184880	21-Jul	1	240	*AMTI (n=1)*	*THEL (n=2)*
712	456850	4185880	21-Jul	1	240	--	*THEL (n=1)*
751	457850	4185880	2-Aug	1	180	--	--
752	458850	4185880	2-Aug	1	240	--	--
753	459850	4185880	21-Jul	1	240	--	--
754	460850	4185880	25-Jul	1	240	--	*THEL (n=1)*
839	460880	4187880	25-Jul	1	405	--	--
840	461850	4187880	25-Jul	1	360	--	*THEL (n=1)*
1088	457850	4193880	8-Jul	1	240	--	--
1089	458850	4193880	8-Jul	1	120	--	--
1129	456850	4194880	8-Jul	1	300	--	--
1130	457850	4194880	8-Jul	1	135	--	--
1131	458850	4194880	8-Jul	1	135	--	--
1253	454850	4197880	2 Jun; 12 Jul	2	585	--	--
1254	455850	4197880	21-Jun	1		--	--
1294	453850	4198880	23-Jun	2	630	--	--
1296	455850	4198880	22-Jun	1	270	--	--
1335	452850	4199880	23-Jun	1	360	--	--

Location (cell)	Easting	Northing	Date	no. of visits	Search time (min.)	Amphibians	Reptiles
1337	454850	4199880	22-Jun	1	180	--	--
1378	453850	4200880	22-Jun	1	360	--	--
ELPO			19, 20 May; 26 Jul	2	900	--	*PICA (n=1)*
INBP	447020	4176336	18 May; 22 Jul	2	830	*AMTI (n=1)*	--
INSP	444935	4179906	19-May	1	130	*BUWO (n=2)*	--
LISP	445023	4174911	19-May	1	140	*AMTI (n=3)*	--
SPFO	447903	4170285	18 May; 22 Jul	2	20	*SPBO (n=1)*	--
night survey 1	454350	4175000	24-Jul	1	--	*SPBO*	--
night survey 2	454393	4176671	25-Jul	1	--	*BUWO*	--

BUWO = Woodhouse's Toad (*Bufo woodhousii*)
AMTI = Tiger Salamander (*Ambystoma tigrinum*)
SPBO = Spadefoot Toad (*Spea bombifrons*)
SCUN = Fence Lizard (*Scleroporus undulatus*)
PICA = Bullsnake (*Pituophis catenifer*)

Table 1: B. VES 2002

Location	UTMs NAD 27 zone 13	no. of visits	Date	Estimated search time (min.)	Amphibians	Reptiles
Little Spring	445003E/ 4174901N	1	29-May	118	BUWO adults (n = 10 males)	--
West Elk Pond	444094E/ 4181510N	1	16-Jun	102	BUWO adults (n = 2) and larvae (n = 50); AMTI larvae (n= 20-30)	--
Medano Creek - start point	461805E/ 4188618N	1	9-Jul	6	--	--
Medano Creek bed	461667E/ 4187823N	1	9-Jul	10	--	THEL (n = 1)
Active Beaver pond 1	461406E/ 4187319N	1	9-Jul	10	--	--
Active beaver pond 2	461207E/ 4137152N	1	9-Jul	10	--	--
Active beaver complex	461174E/ 4187070N	1	9-Jul	10	--	--
Deserted beaver pond 2	20-30 meters downstream from Active Beaver Pond 2.	1	9-Jul	10	--	--
Active beaver pond 3	460928E/ 4186902N	1	9-Jul	20	--	THEL (n = 3)
Beaver complex 2	460695E/ 4186849N	1	9-Jul	30	--	THEL (n = 2)
Point 1	460450E/ 4186652N	1	12-Jul	10	--	--
Point 2	460118E/ 4186444N	1	12-Jul	20	--	THEL (n = 1)
Beaver complex 1	458874E/ 4185104N	1	12-Jul	20	--	THEL (n = 2)

BUWO = Woodhouse's Toad (*Bufo woodhousii*)
AMTI = Tiger Salamander (*Ambystoma tigrinum*)
SPBO = Spadefoot Toad (*Spea bombifrons*)
SCUN = Fence Lizard (*Scleroporus undulatus*)
PICA = Bullsnake (*Pituophis catenifer*)

Table 2: Pitfall Trap Arrays

A. Amphibians and reptiles caught 2001

	Hawthorne	Sand Sheet	Denton Springs
Session 1			
Session 2			2 SCUN
Session 3		8 SPBO	
Session 4		3 SPBO	1 SCUN

B. Amphibians and reptiles caught 2002

	East Elk Pond	Hawthorne	Indian Spring	Little Spring	Sand Sheet	Denton Springs
Session 1	3 BUWO 1 AMTI			1 BUWO		
Session 2			2 BUWO 1 AMTI			1 SCUN
Session 3				2 BUWO *3 Bufo woodhousii* 1 AMTI		
Session 4	1 BUWO 2 AMTI		1 PICA	7 AMTI *7 Ambystoma tigrinum*		

Animals in italics in table were mortalities.
BUWO = Woodhouse's Toad (*Bufo woodhousii*)
AMTI = Tiger Salamander (*Ambystoma tigrinum*)
SPBO = Spadefoot Toad (*Spea bombifrons*)
SCUN = Fence Lizard (*Scleroporus undulatus*)
PICA = Bullsnake (*Pituophis catenifer*)

C. Mammals caught in 2002

	East Elk Pond	Hawthorne	Indian Spring	Little Spring	Sand Sheet	Denton Springs
Session 1	1 mouse 1 shrew 1 grasshopper mouse *1 Sorex sp.*	1 mouse	1 pocket gopher 3 mice	1 mouse 1 pocket gopher *1 Peromyscus sp.*	6 grasshopper mice	
Session 2		2 mice 1 grasshopper mouse	1 pocket gopher 11 mice *3 Peromyscus maniculatus*	1 mouse 3 pocket gophers 2 voles 1 Kangaroo rat	3 grasshopper mice	4 mice *1 Peromyscus sp.*
Session 3	2 pocket gophers	4 voles 2 mice *1 Microtus sp.*	7 mice 2 pocket gophers 1 vole 1 shrew *1 Sorex sp.*	3 voles 1 pocket gopher	2 kangaroo rat 1 grasshopper mouse	1 mouse
Session 4	1 kangaroo rat	5 voles *1 Microtus sp.*	1 pocket gopher	1 vole 1 kangaroo rat	1 shrew	1 mouse

Animals in italics in table were mortalities.

Table 3: Pitfall trapping summary 2001-2002 (following page).

Site	UTM Easting	UTM Northing	Error (m)	Vegetation Description	# of Buckets 2001 / 2002	# of Snake Traps 2002	Total days open 2001 / 2002	# of sessions 2001 / 2002	# of days between sessions 2001 / 2002	Total Trap Nights 2001 / 2002	Animals Caught 2001	Animals Caught 2002
Little Spring	445003	4174901	4	ecotone between the riparian habitat (sedges and rushes) of spring and sparse shrub vegetation of the dune field	--/10	--/3	--/21	--/4	--/7-9	--/210	--	3 BUWO; 8 AMTI
Sand Sheet	448435	4171969	5	area with shrubs and grasses 30-40% cover No standing water	4/10	--/3	23/25	5/4	4-13/7-9	92/250	11 SPBO	--
Indian Spring	445040	4180027	5	ecotone between riparian habitat (sedges and rushes) and dense (70-80%) shrub cover	--/10	--/3	--/25	--/4	--/7-9	--/250	--	2 BUWO; 1 AMTI; 1 PICA
East Elk Pond	444317	4181632	4	riparian area with dense sedges and rushes	--/10	--/3	--/25	--/4	--/7-9	--/250	--	4 BUWO; 3 AMTI
Denton Springs	453892	4172405	6	50 meters above spring in a pinyon-juniper forest	4/10	--/3	24/25	5/4	4-13/7-9	96/250	3 SCUN	1 SCUN
Hawthorne	456028	4183282	5	shrub dominated area amidst hawthorne trees approximately 100 meters from stream	4/10	--/3	22/25	5/4	4-13/7-9	88/250	--	--
Totals					**12/60**	**18**	**69/146**			**276/1460**		

Table 4: Voucher specimens collected, accession numbers and location.

Location	Species	Age class	Number	Date	Comment
Medano Creek	*Bufo woodhousii*	adult	18110	17-May-01	FORT
Beaver Ponds	*Ambystoma tigrinum*	larvae (6)	18114	18-May-01	FORT
Spadefoot Pond	*Spea bombifrons*	adult	18111	18-May-01	FORT
Spadefoot Pond	*Spea bombifrons*	adult	18112	18-May-01	FORT
Little Spring	*Ambystoma tigrinum*	adult	18113	19-May-01	FORT
Little Spring	*Ambystoma tigrinum*	larvae (3)	18115	19-May-01	FORT
Indian Spring	*Bufo woodhousii*	adult	18116	19-May-01	FORT
Indian Spring	*Bufo woodhousii*	adult	18117	19-May-01	FORT
Indian Spring	*Bufo woodhousii*	adult	18118	19-May-01	FORT
Elk Ponds	*Ambystoma tigrinum*	adult	18119	20-May-01	FORT
Denton Spring	*Sceloporus undulatus*	adult	18120	03-Jun-01	FORT
Sand Sheet Pitfall	*Spea bombifrons*	adult	---	08-Jul-01	Found dead, not appropriate as voucher
Sand Sheet Pitfall	*Spea bombifrons*	adult	---	08-Jul-01	Found dead, not appropriate as voucher
Sand Sheet Pitfall	*Spea bombifrons*	adult	---	08-Jul-01	Found dead, not appropriate as voucher
Sand Sheet Pitfall	*Spea bombifrons*	adult	---	08-Jul-01	Found dead, not appropriate as voucher
Elk Ponds	*Ambystoma tigrinum*	adult	---	09-Jul-01	Found dead, not appropriate as voucher
Beaver Pond near visitor center	*Thamnophis elegans*	adult	18121	24-Jul-01	FORT
county Road 150	*Pituophis catenifer*	adult	18122	13-May-02	FORT
East Elk Pond	*Bufo Woodhousii*	Adult	18123	14-May-02	FORT
East Elk Pond	*Bufo Woodhousii*	Adult	18124	15-May-02	FORT
Little Spring	*Bufo Woodhousii*	Adult	18125	17-May-02	FORT
East Elk Pond	*Ambystoma tigrinum*	Adult	18126	20-May-02	FORT
Denton Springs	*Sceloporus undulatus*	Juvenile	18127	29-May-02	FORT
Indian Spring	*Ambystoma tigrinum*	Adult	18128	01-Jun-02	FORT
Sand Sheet	*Phrynosoma hernandesi*	juvenile	18129	13-Jun-02	FORT
Indian Spring	*Bufo Woodhousii*	tadpole	18130	15-Jun-02	FORT
West Elk Pond	*Bufo Woodhousii*	tadpole	18131	16-Jun-02	FORT
West Elk Pond	*Ambystoma tigrinum*	paedomorph	18132	16-Jun-02	FORT
Little Spring	*Ambystoma tigrinum*	Juvenile	18133	16-Jun-02	FORT
Sand Sheet	*Phrynosoma hernandesi*	adult	18134	17-Jun-02	FORT
East Elk Pond	*Ambystoma tigrinum*	Adult	18136	29-Jun-02	FORT
East Elk Pond	*Bufo Woodhousii*	Adult	18138	29-Jun-02	FORT
Indian Spring	*Pituophis catenifer*	Adult	18129	29-Jun-02	FORT
East Elk Pond	*Ambystoma tigrinum*	Adult	18137	29-Jun-02	FORT
Medano Creek bed	*Thamnophis elegans*	adult	18140	09-Jul-02	FORT
Active beaver pond 3	*Thamnophis elegans*	adult	18141	10-Jul-02	FORT
Beaver complex 2	*Thamnophis elegans*	adult	18143	10-Jul-02	FORT
Beaver complex 2	*Thamnophis elegans*	adult	18143	10-Jul-02	FORT
Beaver complex 1	*Thamnophis elegans*	adult	18145	12-Jul-02	FORT
Beaver complex 1	*Thamnophis elegans*	adult	18146	12-Jul-02	FORT
Point 2	*Thamnophis elegans*	adult	18144	12-Jul-02	FORT

Fig. 1. Pitfall trap arrays. Dashed line indicates the pilot arm of the array (4 buckets). A. Hawthorne, B. Denton Springs, C. Sand Sheet, D. East Elk Pond, E. Little Spring, F. Indian Spring.

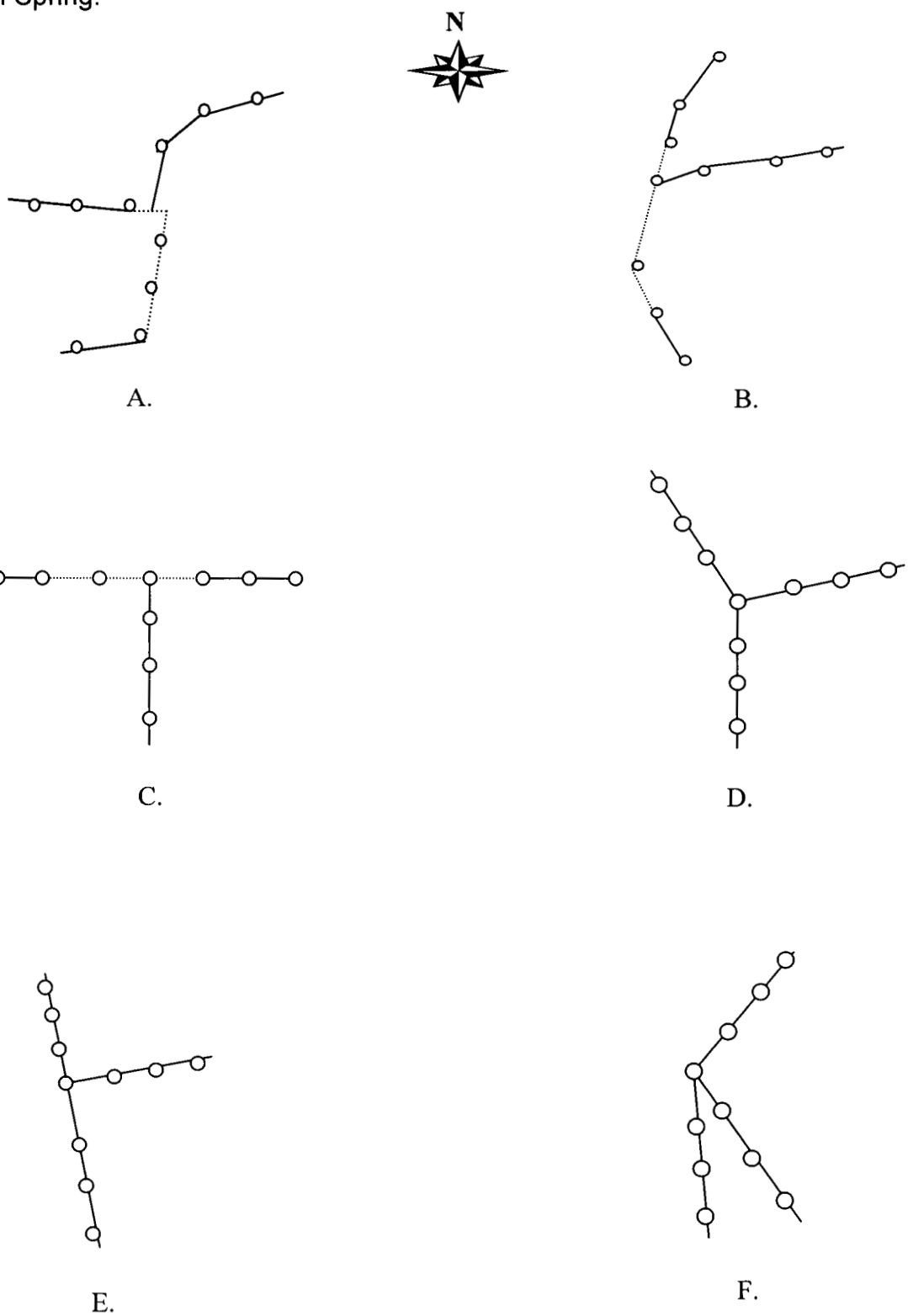
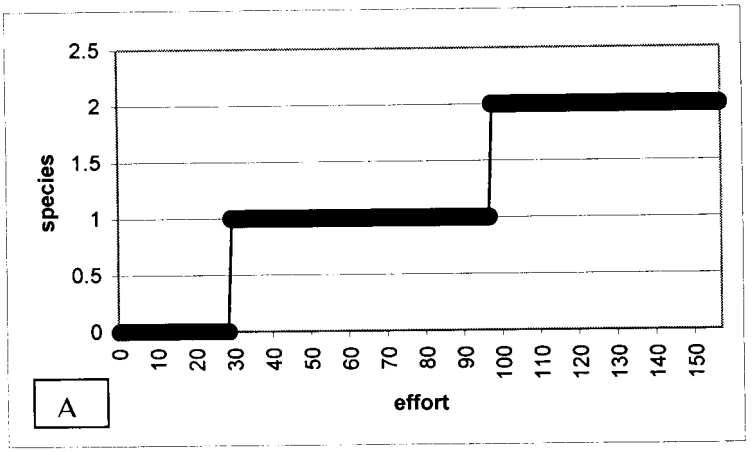
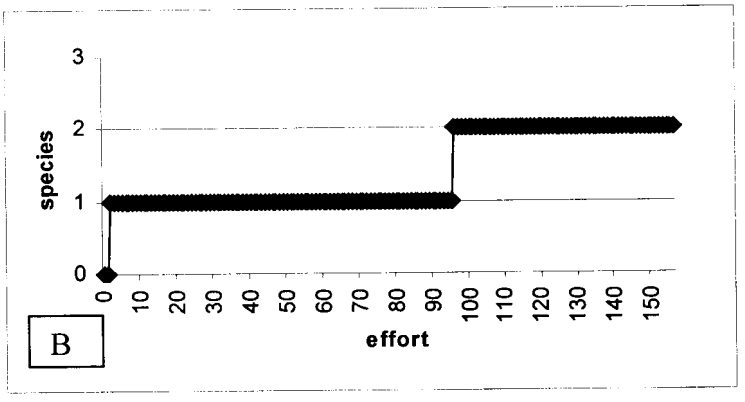


Fig. 2: Map of Great Sand Dunes National Monument and Preserve denoting survey sites for 2001-2002.

Figure 3: A. Trial pitfall arrays 2001, amphibians and reptiles; B. Trial pitfall arrays 2001 mammals. Effort = trap nights. C. VES surveys 2001: squares = amphibians, diamonds = reptiles, effort = person hours.





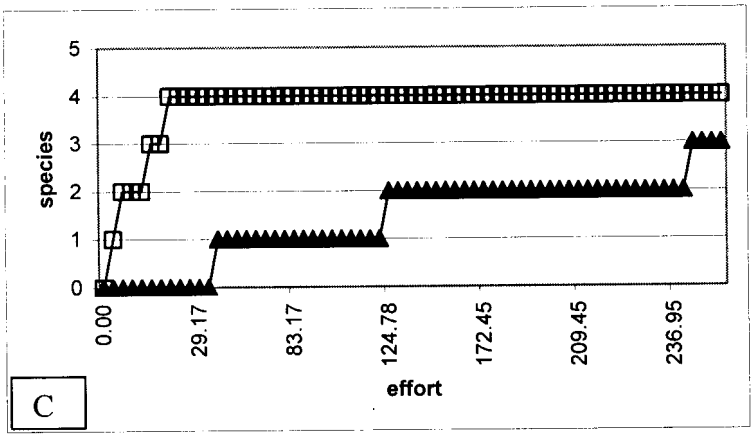
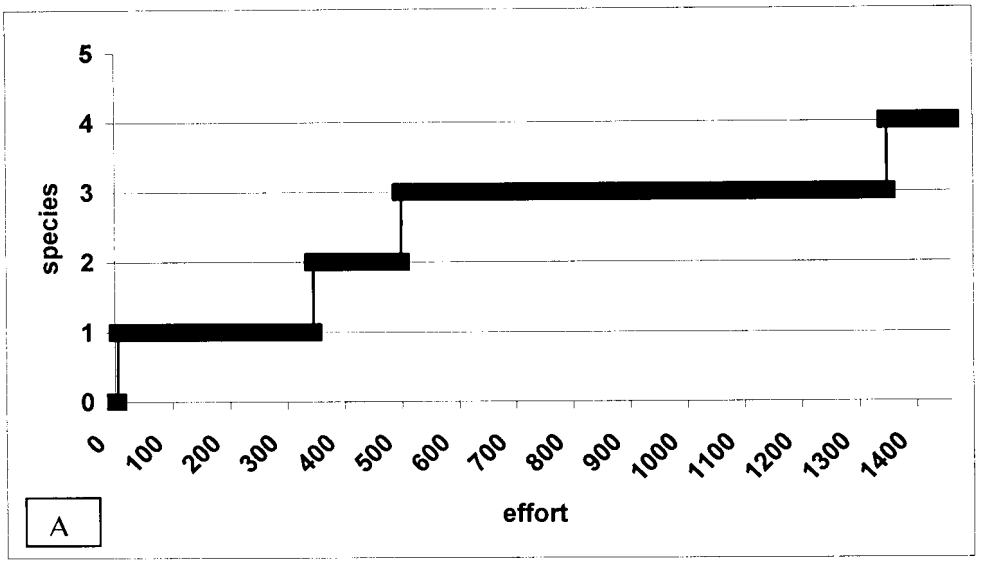
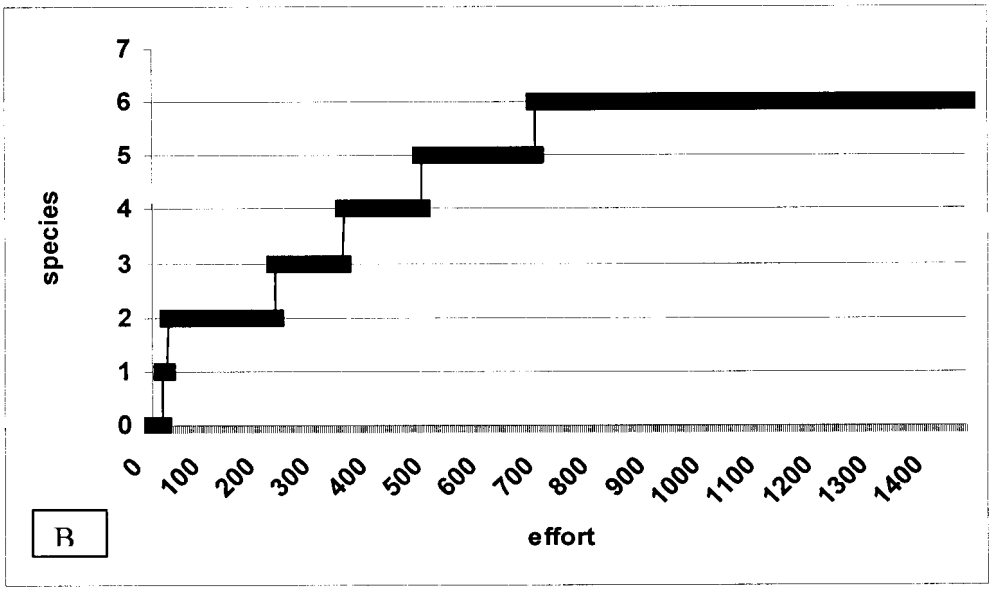


Figure 4: Trial pitfall arrays 2002: Effort = trap nights. A. Amphibians and reptiles B. Mammals



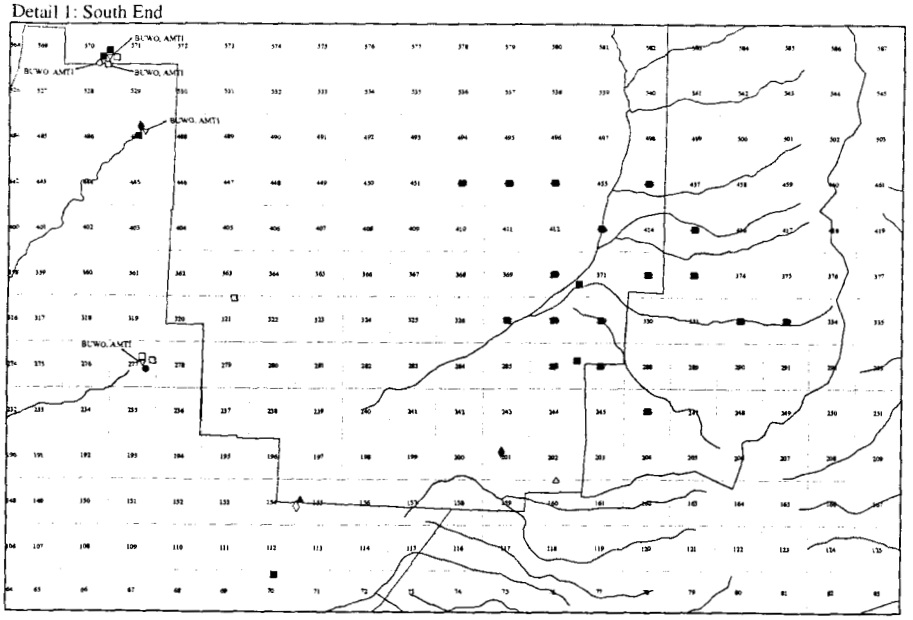


APPENDIX I: Anecdotal and documented occurrences of amphibians and reptiles in and around GRSA

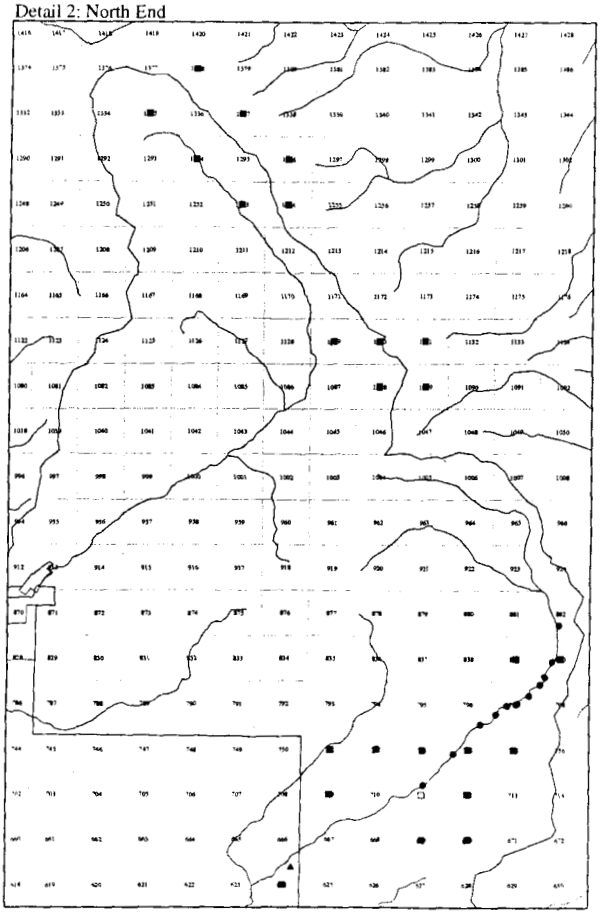
species	common name	location	date of sighting	source	contact information for source / comments
Spea multiplicata	New Mexico spadefoot toad	Baca Ranch	23-Jun-97	Jeremy Siemers	Colorado Natural Heritage Program, jsiemers@holly.ColoState.edu. NOTE: Specimens were juveniles, upon examination, they were indistinguishable from some juvenile S. bombifrons from NE Colorado (G.A. Hammerson, pers. comm. October 2002). This casts doubt on this record, but does not preclude incidence of S. multiplicata in the SVL.
Spea bombifrons	plains spadefoot toad	Baca Ranch, Saguache Cty. Wetlands on S side of -E- Rd, 3 km E 63 Rd	23-Jun-97	Mike Wunder, J. Siemers, A. Ochs	Herpetological Review 29:50; Colorado Natural Heritage Program, jsiemers@holly.ColoState.edu
Spea bombifrons	plains spadefoot toad	Medano Creek	several yrs prior to 2002	Tim Armstrong	Adams State College, taarmstr@adams.edu
Pituophis catenifer	bull snake	south of GRSA boundary	spring 1998	Tim Armstrong	Adams State College, taarmstr@adams.edu
Rana pipiens	leopard frog	Blanca Wetlands (USFWS)	Jun-02	Jill Lucero, Erin Muths	Jill Lucero/LJFO/CO/BLM/DOI@BLM
Rana pipiens	leopard frog	GRSA	??	Fred Bunch	GRSA, Fred_Bunch@nps.gov
Pseudacris triseriata	chorus frog	ditch along road into Medano-Zapata Ranch	May-01	Erin Muths	USGS, Fort Collins Science Center, erin_muths@usgs.gov
Chrysemys picta	Western painted turtle	Indian Spring, Medano Zapata Ranch	Aug-00	Hobey Dixon	pixies@amigo.net, identification by T. Armstrong from photos (Hobey has the photos)
Liochlorophis vernalis	smooth green snake	drainages north of GRSA	2002?	Tim Armstrong	Adams State College, taarmstr@adams.edu
Liochlorophis vernalis	smooth green snake	Little Cherry Creek (drainage N of Crestone)	summer 2002	Tim Armstrong	Dr. Armstrong has a specimen from this location. Habitat similar to that at GRSA/Preserve
Liochlorophis vernalis	smooth green snake	Cotton Canyon (drainage N of Crestone)	summer 2002	Tim Armstrong	Habitat similar to that at GRSA/Preserve
Crotalus viridis	rattlesnake	Oasis store, south of GRSA boundary	2002	tourist (GRSA has photos)	
Crotalus viridis	rattlesnake	South Chained Area	1973?	Hobey Dixon	Detected during summer workshop field trips
Crotalus viridis	rattlesnake	South Chained Area	1975?	Hobey Dixon	Detected during summer workshop field trips
Crotalus viridis	rattlesnake	South Chained Area	1983	Hobey Dixon	Detected during summer workshop field trips
Crotalus viridis	rattlesnake	East of outlier motel, pinyon juniper	1988?	Hobey Dixon	Skink and rattlesnake on same date
Eumeces multivirgatus	skink	East of outlier motel, pinyon juniper	1988?	Hobey Dixon	Skink and rattlesnake on same date

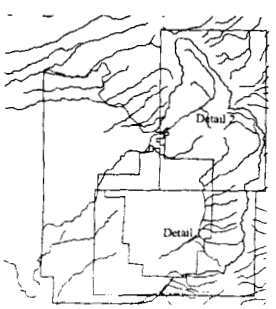
Map of GRSA indicating survey locations for 2001 - 2002; cells, VES, pitfall trap arrays, and incidental sightings.
Shape denotes survey type, color denotes species detected.

Detail 1: South End



Detail 2: North End





Legend

- A. tigrinum
- B. cognatus
- B. woodhousii
- P. catenifer
- P. hernandesi
- S. bombifrons
- S. undulatus
- T. elegans
- Multiple Species
- No detections
- VES, creek, 2002
- Pitfall Array, 2001- 2002
- Pitfall Array, 2002 only
- Incidentals, 2002
- VES Cells, 2001
- Monument Boundary
- Preserve Boundary
- TNC Property Boundary
- Hydrology

0 1 2 3 4 5 km

N
W E
S

Universal Transverse Mercator
Zone 13
North American Datum of 1927

Produced by the
U.S. Geological Survey
Fort Collins Science Center
GIS and Remote Sensing Team
November 1, 2002

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