CRATERS OF THE MOON NATIONAL MONUMENT
BASELINE INVENTORY AND MONITORING
(WILDLIFE)
Final Report-1988

Roger A. Hoffman
Report B-88-4 University of Idaho
Cooperative Park Studies Unit

Subagreement No. 5 to
Cooperative Agreement CA-9000-8-0005

INTRODUCTION

It is the policy of the National Park Service (NPS) to gather baseline inventory data describing the natural resources under its stewardship, and to monitor those resources in perpetuity. Knowledge of the condition of the natural system, both past and present, is essential if these resources are to be managed wisely (Despain et al. 1986). Unfortunately, NPS baseline inventory studies in parks have often been reactionary, taking place only when a problem has become obvious (Mack et al. 1981). Monitoring programs rather than being an early warning system, to detect change before changes become obvious are often overlooked unless resource management difficulties require them.

In recent years the NPS has shown a renewed interest in programs to gather baseline inventory data and to monitor resource parameters. Currently there has been little continuity among programs initiated in various parks and little attempt to develop consistent methods. This project was initiated in part to address these concerns. It will examine the question of what aspects of the environment should be monitored and what level of monitoring is necessary to achieve desired goals. These needs were approached from the viewpoint of a smaller park with no known resource threats, minimal budgets, and limited resource management personnel. The second objective of this study was to produce a complete baseline inventory of the vertebrate resources and a plan for the continued monitoring of these resources at Craters of the Moon National Monument, Idaho (CRMO). The methodology employed in this portion of the study was again designed to be implemented in smaller areas with limited funding and personnel.

The need for such a study at CRMO is clear. In a review of the scientific research that has taken place at CRMO since its establishment in 1924 (Blakesley and Wright 1988), a qualitative assessment was made concerning 11 major areas of study. One of the least complete areas of study (with a completeness estimate of only 10-20%) was that of the fauna of the monument.

STUDY AREA

Craters of the Moon National Monument (43°27'N,113°35'W) is located 29 km (18 mi) southwest of Arco, Idaho. The 217 km^2 (84 sq mi) area encompasses a small portion of the Pioneer Mountains and a chain of cinder cones, the Great Rift. Elevation ranges from 1625 m (5330 ft) along the rift to 2355 m (7725 ft) in the Pioneer Mts. The rift portion is composed of cinder cones, aa, and pahoehoe lava flows (Stearns, 1928). The highest of the cinder cones, Big Cinder, is 200 m (655 ft) higher than the surrounding plain. Twenty-six different vegetation types have been identified and mapped (Day and Wright 1985). The dominant vegetation types in the south are bitterbrush, mountain big sagebrush, and limber pine. Bitterbrush, sagebrush, quaking aspen, Douglas fir and chokecherry stands compose the vegetation in the Pioneer Mountains area. Perennial streams provide free water in the Pioneer Mountains throughout the summer.

Average maximum temperatures range from -1.0° C (30° F) for January to 28° C (82° F) for August with an yearly average maximum of 12.75° C (55° F) (see figure 1). Average minimum temperatures range from -12° C (10° F) for January to 9° C (48° F) for August, the yearly average minimum is -1.15° C (30° F). The average annual precipitation is 41.2 cm (16 in) (1980-1987). May is the wettest month, but most

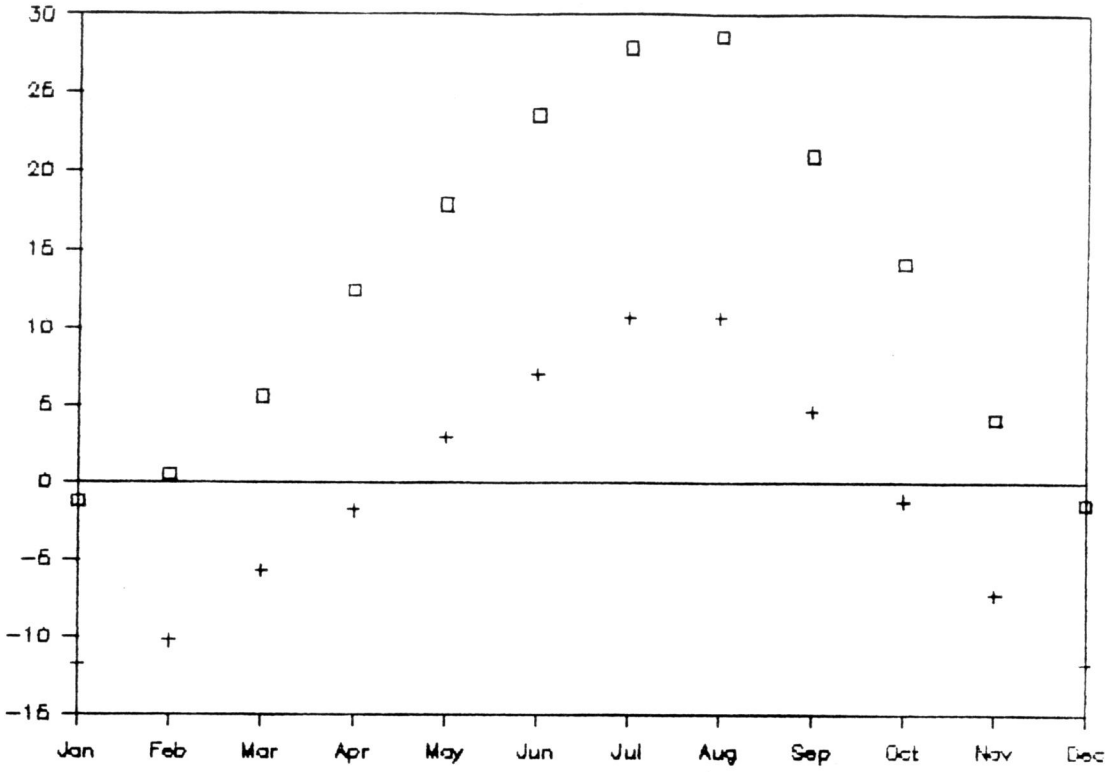


Figure 1. Monthly maximum and minimum temperatures (in degrees Celsius) for Craters of the Moon National Monument, based on 8 years of data from 1980 to 1987.

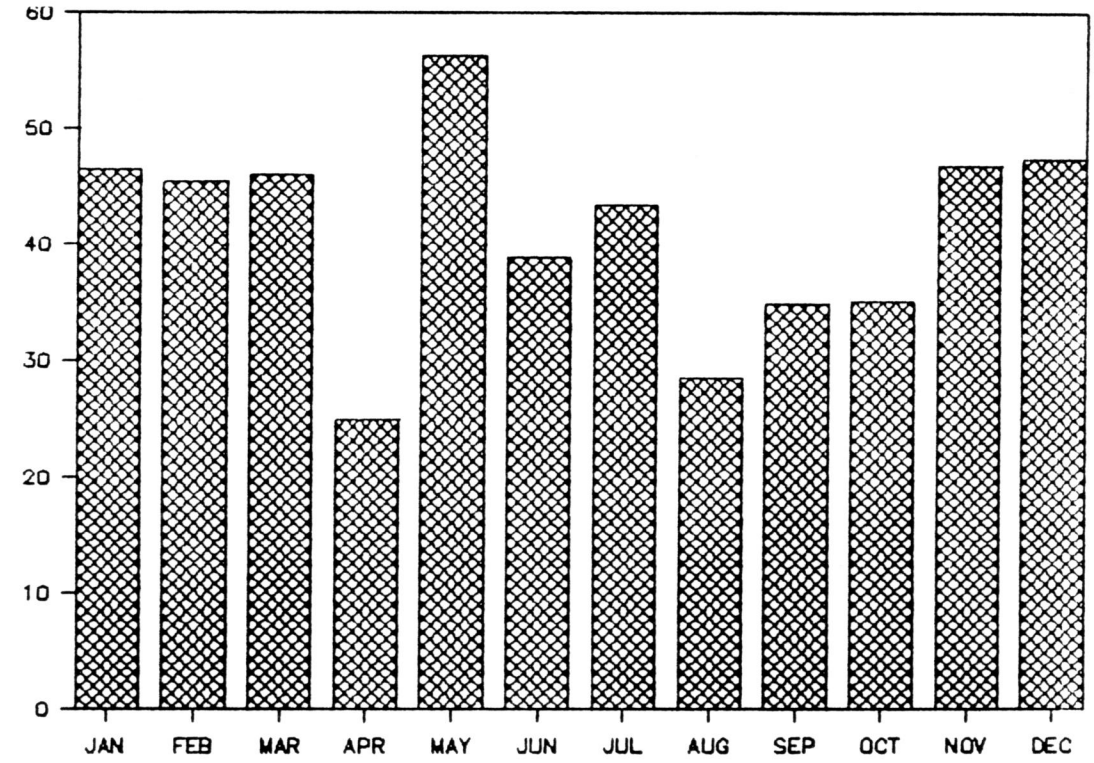


Figure 2. Average monthly precipitation (in centimeters) for Craters of the Moon National Monument, based on 8 years of data from 1980 to 1987.

precipitation falls in the form of snow throughout the winter (see figure 2). The study was conducted during a period of well below normal precipitation (see figure 3) and above normal temperatures (see figure 4). Not only was 1987 drier than normal, it followed several years of below normal precipitation (see figure 5).

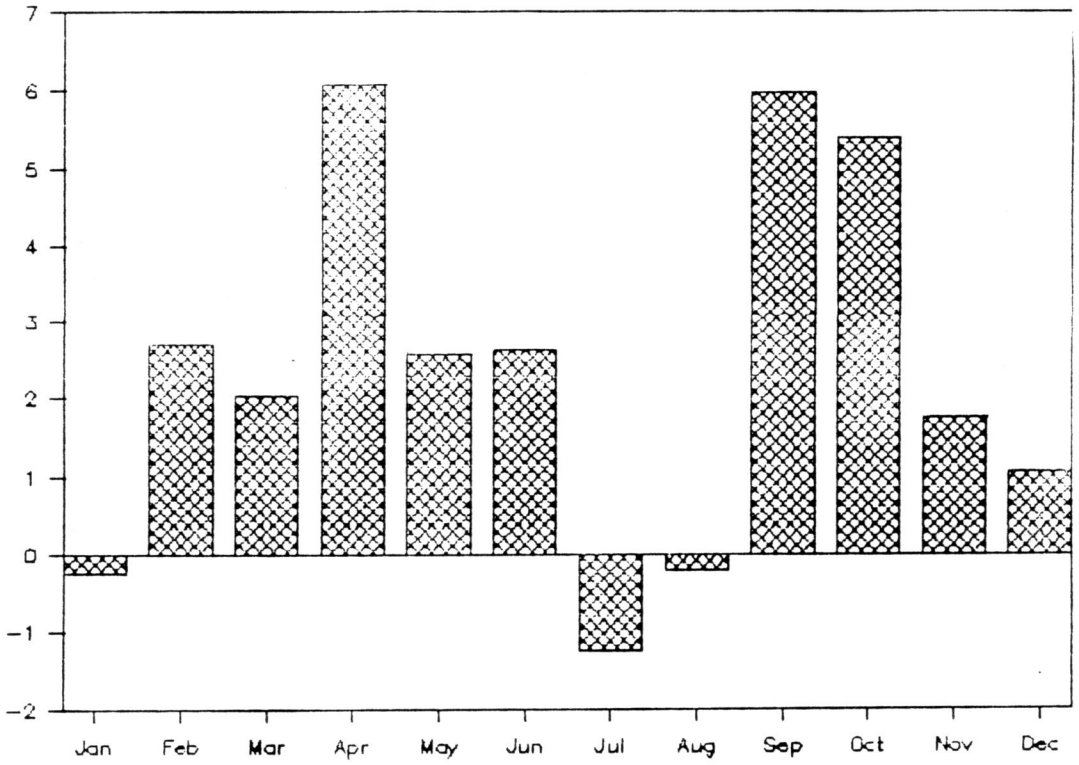


Figure 3. Deviation from normal high temperatures (in degrees Celsius) for 1987 at Craters of the Moon National Monument, as compared to 8 year averages from 1980 to 1987.

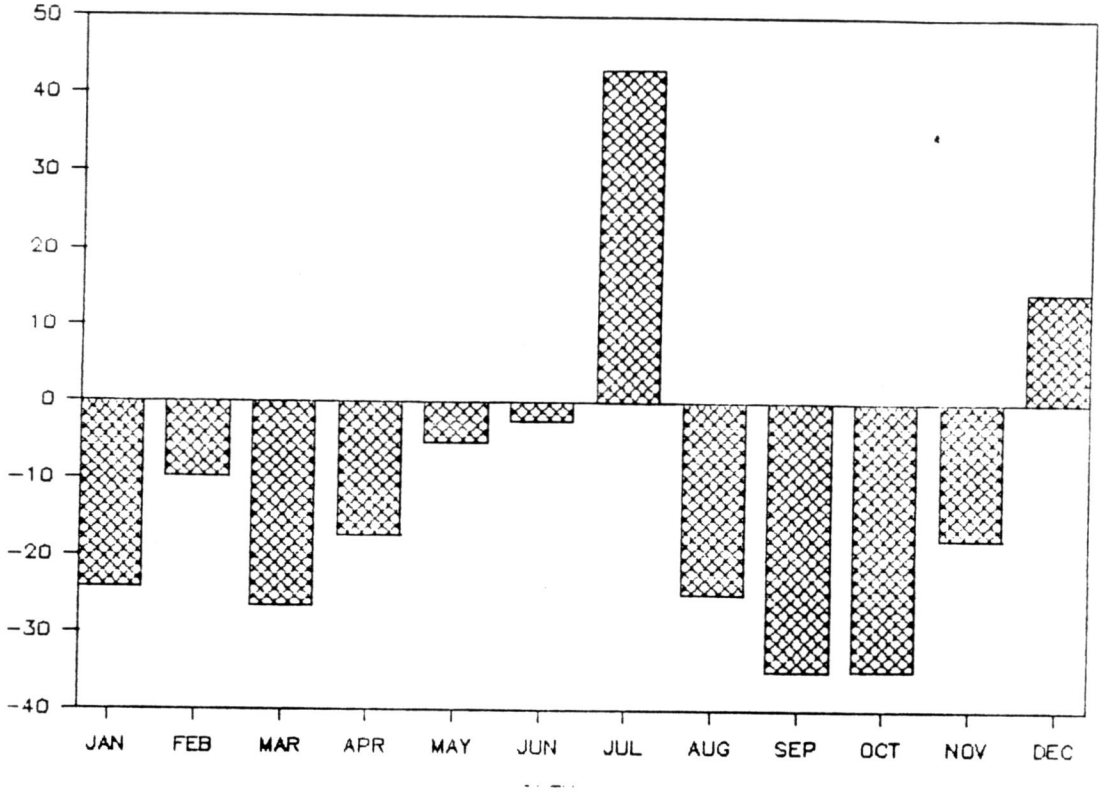


Figure 4. Deviation from normal precipitation (in millimeters) for 1987 at Craters of the Moon National Monument, as compared to 8 year averages from 1980 to 1987.

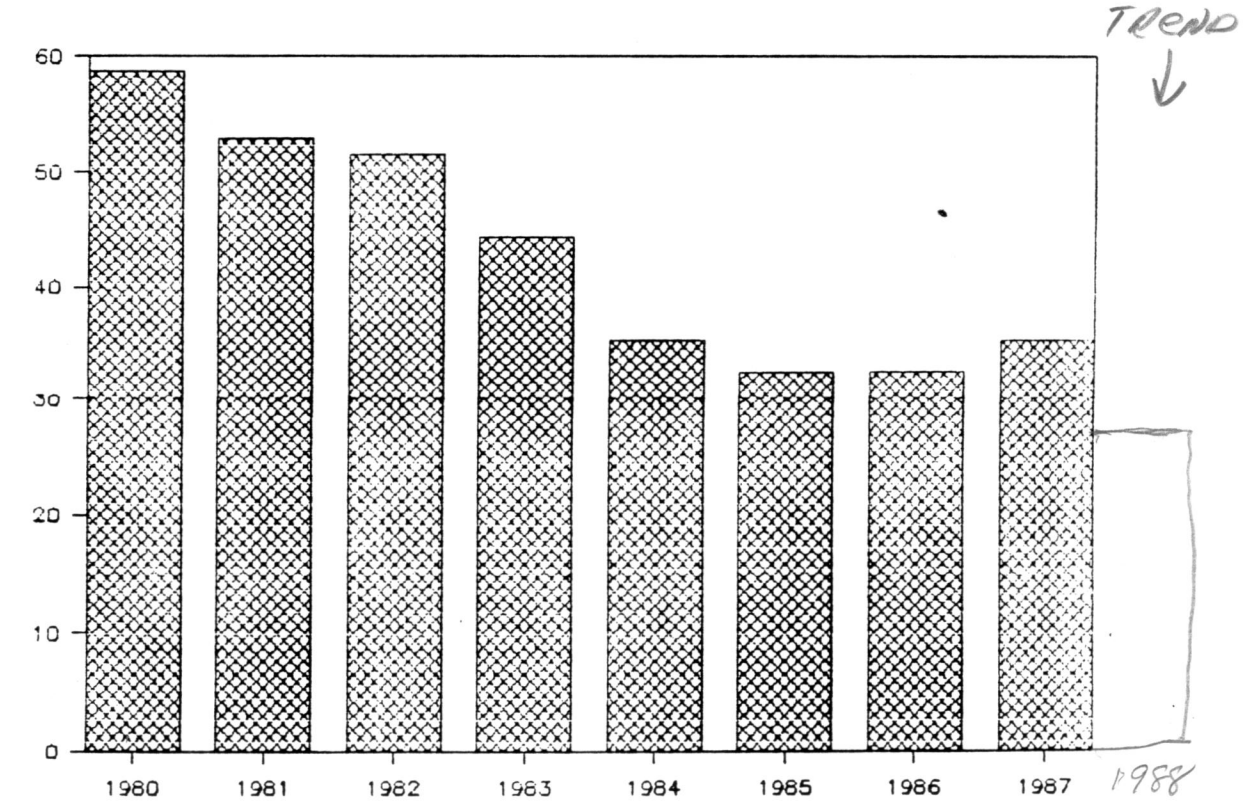


Figure 5. Annual total precipitation (in centimeters) for Craters of the Moon National Monument from 1980 to 1987.

DESIGN CONSIDERATIONS

A number of studies have reviewed inventory and monitoring techniques. Many guidelines have been proposed regarding the design of inventory and monitoring systems. Some are almost universally accepted; 1) the system must be ecologically appropriate, 2) a long-term commitment must be made, 3) the data must be collected in a systematic, statistically sound manner, and 4) the project must be cost-efficient (Halvorson 1984). Garton (1984) presented a detailed analysis of cost-efficient inventory techniques. The most cost-efficient techniques for inventorying or monitoring vertebrate groups have been widely agreed upon. The more basic questions when designing an inventory/monitoring system are 1) What are the purposes of the monitoring system? 2) What aspects of the environment do we need to monitor? 3) And at what level do we need to monitor?

There are four major reasons for natural resource monitoring; 1) to fulfill legal obligations, 2) to determine responses to management activities, 3) to track threats to the resource, and 4) to measure overall protection goals (Buttrick 1984).

Only after determining the reason for an inventory and monitoring program can one proceed with its design. In so doing, decisions on what to monitor need to be made. This is the most problematic stage, once this is decided the actual selection of techniques is based primarily on costs.

An inventory/monitoring system cannot be standardized; it must be tailored to each individual situation (Buttrick 1984). In his review of cost-effective baseline inventories, Garton (1984) stressed the idea of defining the objectives of the inventory; it is necessary to define what

is most significant about each specific management area. This is necessary because to sample all of the taxonomic groups of terrestrial animals on a resource natural area larger than a few hectares is not possible. Garton's (1984) estimate for a cost-efficient inventory was $10-15,000 per 100 ha. The proper selection of what to monitor is essential to simplifying field-work. One must identify and monitor the ecological processes that are most likely to respond to the stresses on the system (Hinds 1984).

Despite the above, a general inventory of all taxonomic groups at a basic level may be valuable. The results of this type of inventory may help resource managers select species that merit further study or to designate others as potential indicator species (Raphael and Rosenberg 1983). Halvorson (1984) also suggested the importance of a pilot study in identifying the focus of further research.

GENERAL INVENTORY TECHNIQUES

For inventories of reptiles and amphibians, it is generally accepted that a combination of pitfall traps and systematic searches is the most efficient (Halvorson 1984, Bury and Raphael 1983, Raphael and Rosenburg 1983, Raphael and Barrett 1981). Modifications to the basic design of the pitfall including installation of drift fences can increase their efficiency.

Birds are best censused using spot-mapping methods. However, these censuses are very labor intensive. Indices of abundance gained through techniques such as the station index (Mannan and Meslow 1981) are useful for inventories and also for detecting trends (Emlen 1981). Index techniques are much more efficient than any of the other census techniques (Halvorson 1984).

The diversity of life-histories and habits found among mammals contributes to the difficulty in sampling this class of organisms. The techniques must be tailored to each group of species and in some cases specifically to the target species.

Small mammals are most efficiently sampled using a combination of trapping techniques (Barrett 1983; Raphael and Barrett 1981, 1983; Raphael and Rosenberg 1983).

Small carnivores typically occur at low densities, are nocturnal and can be difficult to trap. Because of this, track plates consisting of smoked aluminum plates and baited with either food scent or reproductive lure are often used to determine the presence of these and other hard to census species (Clark and Cambell 1983). Track plates or similar devices have also been used to inventory furbearers (Barrett 1983), flying squirrels (Raphael et al. 1986), and small rodents (Lord et al. 1970). Track stations using sifted dirt or snow require less equipment and are possibly more readily accepted by the target animals but the tracks are often less discernable and identification more difficult (Doucet et al. 1985).

The larger carnivores present many of the same problems as the small carnivores. They are mostly nocturnal, occur at very low densities and are exceptionally difficult to trap. In addition to the tracking methods used in surveying smaller carnivores, the larger species have been sampled using self-trip cameras (Goetz 1981, Rappole et al. 1985). The use of self-trip cameras eliminates the disturbance to the animal associated with live-trapping. They are also relatively easy to transport and setup. Cameras provide the positive identification of species sometimes not possible with track stations. Also, less

maintenance is required than track stations in some environments. The major drawback with this technique is the initial cost; $300 each for the systems used by Goetz (1981). However, the eventual savings in time and manpower are considerable.

For a comprehensive inventory of vertebrates, a combination of techniques is required. Avian censuses, pitfall traps, and track stations proved to be the most efficient methods in terms of the number of species detected and real costs in a study performed in old-growth forest (Raphael and Rosenberg 1983). Although this combination of techniques works well for many species. some species require more specialized (and expensive) techniques for sampling. The objectives of the monitoring effort will determine if the added expense is justified for these groups of species.

METHODS USED AT CRMO

Seventeen of the 26 vegetation types identified on the monument (Day and Wright 1985) were selected for sampling because of their dominance, uniqueness or suspected vulnerability to change. These 17 vegetation types comprise 99.8% of the total area of the monument (see_ table 1). Two sampling stations were located in each of these 17 vegetation types. The location of these stations was determined by arbitrarily selecting sites as widely separated as possible in each vegetation type (within constraints of accessibility) without placing the station too near a boundary with another vegetation type. These sites were selected on a map using the above criteria. This mapped point was then located as precisely as reasonably possible in the field. The center of the sampling station was located a random distance (from 10 m

to 50 m or 33 ft to 165 ft) in a random direction (in 10° increments) from this point.

Table 1. The 17 vegetation types sampled and the area each covers on the Monument. (From Day and Wright 1985)

	Vegetation type and Description	Hectares	Percent
1	Cinder Gardens	484	2.2
2	Low Density Lava Flows	12525	57.8
3	Medium Density Lava Flows	2196	10.1
4	Mountain Big Sagebrush/Bluebunch Wheatgrass	1122	5.2
5	Mountain Big Sagebrush/Sandberg Bluegrass	2527	11.7
6	Mountain Big Sagebrush/Needle Grass	315	1.5
8	Mountain Big Sagebrush/Idaho Fescue	98	0.5
11	Three-tip Sagebrush/Idaho Fescue	41	0.2
13	Low Sagebrush/Sandberg Bluegrass	126	0.6
16	Antelope Bitterbrush	477	2.2
17	Antelope Bitterbrush/Great Basin Wildrye	85	0.4
21	Limber Pine/Antelope Bitterbrush (low total cover)	226	1.1
22	Limber Pine/Antelope Bitterbrush (high total cover)	1212	5.6
23	Limber Pine/Antelope Bitterbrush (high density Limber Pine)	87	0.4
24	Douglas-Fir/Mountain Snowberry	29	0.1
25	Upland Quaking Aspen	15	0.07
26	Riparian	30	0.13
	TOTALS	21595	99.80

Amphibians and Reptiles

No systematic methods were used for inventorying the amphibians and reptiles. Searches were performed in the most likely habitats for these groups.

Birds

Birds were sampled using a station index technique (Mannan and Meslow 1981). This is an efficient inventory technique and good for detecting trends with a minimal amount of effort. Each station was

censused three times during the spring in a randomly determined order. Two or three stations were censused each morning depending on the required travel time between stations. The first two rounds of censuses were performed between sunrise and two hours after sunrise (from 4/28 to 6/9 and 5/21 to 7/3 respectively). The last round of censuses was performed in the early afternoon (from 1200 to 1500 hrs) (from 5/28 to 7/13) in an attempt to sample species more easily detected at during mid-day (such as flycatchers and hawks). Each census was made up of three 10 minute sampling periods (for the purposes of monitoring the census efficiency) during which each species detected was recorded. Censuses were performed only when the weather conditions were acceptable; low wind speed (less than 13 km/h or 8 mph) and no precipitation. Strong winds are common at Craters of the Moon National Monument and accounted for many cancelled censuses.

Counts were begun 10 minutes after arriving at a station to allow the birds to readjust to the presence of the observer. This also allowed the observer to become familiar with the species currently singing and to prepare the data form. During the 30 minute period at each census station, a list was compiled of all species detected and a tally kept of the estimated numbers of each species detected during the census period. Only birds within the habitat being censused were counted, in areas where visibility is great, a maximum distance of 400 m (0.25 mile) was used. In many habitats the effective maximum distance was considerably less.

The above method provides a random estimate of the number and kinds of individuals in a particular area. Such methods are used because it is impossible to identify and count each individual in a community. The information from such random samples can however be used to calculate an

estimate of community diversity or the number and relative abundance of all species using the Shannon-Weaver Function (Shannon and Weaver 1949) using the following formula:

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

Where: H' is the Shannon-Weaver estimate of diversity.
S is the number of species.
p_i is the proportion of the total number of individuals consisting of the ith species.

P_i is intended to be the true proportion of each species in the population, however in practice, p_i is estimated by n_i/N where N is the total number of individuals detected and n_i is the number of individuals of species 1.

The combined species list and maximum counts of each species from both stations over all three days was used to calculate the diversity for each vegetation type sampled (see appendix for detail on calculating diversity measures).

Mammals

Mammals were surveyed using a combination of traps and tracking plates. Each station consisted of an arrangement of a variety of traps. Five pitfall traps 16 cm (6 in) in diameter, 36 cm (14 in) deep were baited with rolled oats and sunflower seeds. Eight small sherman live-traps 5 x 6.3 x 16.5 cm (2 x 2.5 x 6.5 in) were baited with peanut butter and rolled oats. Eight large sherman live-traps (7.6 x 8.9 x 23 cm (3 x 3.5 x 9 in) were baited with peanut butter and rolled oats. Five pvc vole traps 3 cm (1 in) in diameter and 25 cm (10 in) long with a one-way funnel in one end and a screen in the other were baited with rolled oats. Four 18 x 18 x 45 cm (7 x 7 x 18 in) havaharts of which two were baited with cat food and two with alfalfa pellets and rolled oats. Two track

plates (one with canine scent, one with feline scent and lure) were also set at each station. All traps were placed at least 36 hours prior to being set. Pitfall traps were pre-baited for one night before being set in an effort to increase the number of captures (Chitty and Kempson 1949). After the prebaiting night, the traps were set each evening as near to dusk as possible and checked the following morning within one hour of sunrise to ensure minimal mortality in the traps due to overheating and dehydration. All stations were operated for four nights. When possible, the nights were consecutive. However, if there was precipitation expected during the night or the winds were strong then the trapping was delayed until the next suitable night.

Many mammal species cannot be easily surveyed using systematic trapping and tracking procedures. Species whose distributions were clumped or irregular such as pika, wood-rat, and marmot were sampled by searching appropriate habitat. Some species which are difficult to sample due to habits include the bats and fossorial species (such as pocket gophers and moles). Bats are one of the hardest groups to sample. Bat traps are considered the most efficient method of sampling species which are not concentrated in their activities such as the cave dwelling species. However, even using bat traps the number of detections can be quite small; in a comprehensive inventory of old-growth forest wildlife, only one bat was captured in 30 nights of operation (Raphael and Barrett 1981).

Bats were searched out in their hibernacula, day-time roosts and collected over water-holes during the evening. Fossorial species such as the pocket gopher were either chanced upon or discovered by finding sign of their presence.

Based on the systematic trapping only, the small mammal diversity was calculated for each vegetation type in the same manner as described for birds.

RESULTS

Amphibians and Reptiles

Two species of amphibians and eight species of reptiles were found on the monument (see table 2). All were found either through searches or in the course of other field work.

Table 2. Amphibians and Reptiles recorded at Craters of the Moon National Monument.

Amphibia
Anura
Bufonidae
Western toad (*Bufo boreas*)
Hylidae
Boreal chorus frog (*Pseudacris triseriata*)
Reptilia
Squamata
Igunidae
Short-horned lizard (*Phrynosoma douglassi*)
Sagebrush lizard (*Sceloporus graciosus*)
Scincidae
Western skink (*Eumeces skiltonianus*)
Boidae
Rubber boa (*Charina bottae*)
Colubridae
Western yellow-bellied racer (*Coluber constrictor*)
Gopher snake (*Pituophis melanoleucus*)
Western garter snake (*Thamnophis elegans*)
Viperidae
Western rattlesnake (*Crotalus viridis*)

Birds

In all, 1220 birds of 64 different species were detected during the censuses. The number of species detected during the three censuses at each station ranged from 2 to 22 (see table 3). The average number of species detected at each station was 10.4. Species varied considerably in their distributions; being found at from only one station (22 species)

to being found at 24 of the 34 stations (mourning dove). The number of species found in a given habitat type ranged from 4 to 34 (see table 4). There was considerable variation in both the numbers of species and species composition between stations in the same habitat types. This is as expected because of the way in which the station locations were determined. It is believed that the greatest variety of habitats was sampled by this design.

The majority (81.7%) of all species identified were detected during the first of the three 10 minute census periods. The second census period accounted for 14.8% of the detected species while only 3.5% of the detected species were not detected until the third 10 minute census period. This varied considerably between stations in vegetation of different structures; for the sparsely vegetated areas and those with low vegetation (lavas, bitterbrush and sagebrush communities) the first period accounted for 90.2% of all detections, the second 8.7% and the third only 1.1%. In censuses of the more complex vegetations types (riparian, aspen, limber pine and Douglas fir communities) only 73.9% of the species were detected in the first period, 20.5% in the second and 5.6% in the third.

During the morning censuses, 67.3% of all species were first detected by sound while only 32.7% were first detected by sight. The afternoon censuses relied more on visual (55.8%) than audio (44.2%) detections presumably because fewer birds were singing in the afternoon.

In addition to the censuses, casual observations brought the number of bird species recorded on the monument to 148 (see table 5).

Table 3. Birds detected during censuses and the vegetation types in which each was found.

Family / Species	Vegetation types																
	1	2	3	4	5	6	8	11	13	16	17	21	22	23	24	25	26
Accipitridae																	
Northern harrier				4	5					16	17						26
Red-tailed hawk														23			
Golden eagle									13								
Falconidae																	
American kestrel		2				6	8	11	13	16		21		23	24		26
Phasianidae																	
Blue grouse		2					8		13						24	25	26
Sage grouse								11	13							25	26
Columbidae																	
Rock dove									13								
Mourning dove		2	3	4	5	6	8	11	13	16		21	22	23	24	25	26
Caprimulgidae																	
Common nighthawk								11		16							
Trochilidae																	
Rufous hummingbird			3			6								23	24		
Picidae																	
Lewis' woodpecker	1									16		21	22		24	25	26
Red-naped sapsucker												21					
Northern flicker		2	3	4		6	8			16		21	22	23	24	25	26
Tyrannidae																	
Olive-sided flycatcher														23			
Dusky flycatcher					5									23	24	25	
Hammond's flycatcher													22				
Say's phoebe		2	3														
Hirunidinidae																	
Violet-green swallow		2		4			8	11				21	22	23			
Tree swallow													22				26
Barn swallow						6											
Corvidae																	
Clark's nutcracker		2				6				16		21	22	23	24		26
Black-billed magpie															24	25	
American crow									13	16							26
Common raven	1	2		4		6			13			21			24		
Paridae																	
Black-capped chickadee																	26
Mountain chickadee												21	22	23	24	25	26
Sittidae																	
Red-breasted nuthatch													22	23	24	25	
Certhiidae																	
Brown Creeper														23	24		
Troglodytidae																	
Rock wren		2	3	4	5	6		11	13		17	21	22				
House wren															24	25	26
Winter wren															24		26
Muscicapidae																	
American robin	1									16		21		23	24	25	26
Hermit thrush															24		

Table 3 (cont.). Birds detected during censuses and the vegetation types in which each was found.

Family / Species	Vegetation types																
	1	2	3	4	5	6	8	11	13	16	17	21	22	23	24	25	26
Muscicapidae (cont.)																	
Swainson's thrush													22	23		25	
Mountain bluebird		2		4	5						17	21	22	23		25	
Townsend's solitaire		2														25	
Ruby-crowned kinglet														23	24		26
Mimidae																	
Sage thrasher			3	4	5	6	8	11		16	17	21					
Laniidae																	
Loggerhead shrike							8	11									
Sturnidae																	
European starling									13								
Vireonidae																	
Warbling vireo															24		26
Emberizidae																	
Orange-crowned warbler																25	26
Yellow warbler																25	26
Yellow-rumped warbler												21		23	24	25	
MacGillivray's warbler																	26
Wilson's warbler															24		
Western tanager													22	23	24	25	26
Lazuli bunting			3											23	24		26
Green-tailed towhee				4	5	6	8	11			17	21	22	23	24		26
Rufous-sided towhee			3	4	5	6	8	11	13	16	17	21	22	23	24	25	26
Vesper sparrow				4	5	6	8	11	13		17					25	
Lark sparrow			3					11									
Black-throated sparrow			3														
Dark-eyed junco								11							24	25	
Chipping sparrow												21	22	23	24	25	
Brewer's sparrow	1		3	4	5	6	8	11	13	16	17	21	22	23			
White-crowned sparrow					5												
Fox sparrow																	26
Western meadowlark				4	5	6	8	11		16	17						
Brewer's blackbird		2		4	5		8	11	13	16	17	21			24	25	
Brown-headed cowbird			3								17	21	22	23	24		26
Fringillidae																	
Cassin's finch				4									22	23	24	25	
Pine siskin														23	24		
American goldfinch																25	

Table 4. Numbers of species detected in each vegetation type during bird censuses.

Vegetation type	# species detected station 1	station 2	total
1	3	2	4
2	6	9	12
3	9	9	12
4	11	9	15
5	12	7	13
6	13	6	14
8	7	10	13
11	12	5	16
13	9	9	14
16	11	9	14
17	8	5	11
21	15	11	20
22	14	15	20
23	18	19	26
24	22	17	34
25	13	16	25
26	21	16	26

Table 5. All birds recorded at Craters of the Moon National Monument to date.

Grebes (Podicipedidae)
  Eared grebe (Podiceps nigricollis)
Herons (Ardeidae)
  Great blue heron (Ardea herodias)
Swans, geese, ducks (Anatidae)
  Tundra swan (Cygnus columbianus)
  Snow goose (Chen caerulescens)
  Canada goose (Branta canadensis)
  Green-winged teal (Anas crecca)
  Mallard (Anas platyrhynchos)
  Blue-winged teal (Anas discors)
Vultures (Cathartidae)
  Turkey vulture (Cathartes aura)
Eagles, hawks (Accipitridae)
  Bald eagle (Haliaeetus leucocephalus)
  Northern harrier (Circus cyaneus)
  Sharp-shinned hawk (Accipiter striatus)
  Cooper's hawk (Accipiter cooperii)
  Swainson's hawk (Buteo swainsoni)
  Red-tailed hawk (Buteo jamaicensis)
  Ferruginous hawk (Buteo regalis)
  Rough-legged hawk (Buteo lagopus)
  Golden eagle (Aquila chrysaetos)

Table 5 (cont.). All birds recorded at Craters of the Moon National Monument to date.

Falcons (Falconidae)
- American kestrel (*Falco sparverius*)
- Merlin (*Falco columbarius*)
- Prairie falcon (*Falco mexicanus*)

Partridge, grouse (Phasianidae)
- Gray partridge (*Perdix perdix*)
- Chukar (*Alectoris chukar*)
- Ring-necked pheasant (*Phasianus colchicus*)
- Blue grouse (*Dendragapus obscurus*)
- Ruffed grouse (*Bonasa umbellus*)
- Sage grouse (*Centrocercus urophasianus*)

Plovers (Charadriidae)
- Killdeer (*Charadrius vociferus*)

Sandpipers (Scolopacidae)
- Spotted sandpiper (*Actitis macularia*)
- Common snipe (*Gallinago gallinago*)

Gulls (Laridae)
- Ring-billed gull (*Larus delawarensis*)
- California gull (*Larus californicus*)

Doves, pigeons (Columbidae)
- Rock dove (*Columba livia*)
- Band-tailed pigeon (*Columba fasciata*)
- Mourning dove (*Zenaida macroura*)

Owls (Strigidae)
- Great horned owl (*Bubo virginianus*)
- Long-eared owl (*Asio otus*)
- Short-eared owl (*Asio flammeus*)
- Northern saw-whet owl (*Aegolius funereus*)

Goatsuckers (Caprimulgidae)
- Common nighthawk (*Chordeiles minor*)
- Common poorwill (*Phalaenoptilus nuttallii*)

Swifts (Apodidae)
- White-throated swift (*Aeronautes saxatalis*)

Hummingbirds (Trochilidae)
- Black-chinned hummingbird (*Archilochus alexandri*)
- Calliope hummingbird (*Stellula calliope*)
- Rufous hummingbird (*Selasphorus rufus*)

Kingfishers (Alcedinidae)
- Belted kingfisher (*Ceryle alcyon*)

Woodpeckers (Picidae)
- Lewis' woodpecker (*Melanerpes lewis*)
- Red-headed woodpecker (*Melanerpes erythrocephalus*)
- Red-naped sapsucker (*Sphyrapicus nuchalis*)
- Williamson's sapsucker (*Sphyrapicus thyroideus*)
- Downy woodpecker (*Picoides pubescens*)
- Hairy woodpecker (*Picoides villosus*)
- Northern flicker (*Colaptes auratus*)

Flycatchers (Tyrannidae)
- Olive-sided flycatcher (*Contopus borealis*)
- Western wood-pewee (*Contopus sordidulus*)
- Willow flycatcher (*Empidonax traillii*)

Table 5 (cont.). All birds recorded at Craters of the Moon National Monument to date.

Flycatchers (Tyrannidae) (cont.)
- Hammond's flycatcher (Empidonax hammondii)
- Dusky flycatcher (Empidonax oberholseri)
- Western flycatcher (Empidonax difficilis)
- Say's phoebe (Sayornis phoebe)
- Ash-throated flycatcher (Myiarchus cinerascens)
- Western kingbird (Tyrannus verticalis)
- Eastern kingbird (Tyrannus tyrannus)

Larks (Alaudidae)
- Horned lark (Eremophila alpestris)

Swallows (Hirundinidae)
- Tree swallow (Tachycineta bicolor)
- Violet-green swallow (Tachycineta thalassina)
- Barn swallow (Hirundo rustica)

Jays, magpies and crows (Corvidae)
- Steller's jay (Cyanocitta stelleri)
- Pinyon jay (Gymnorhinus cyanocephalus)
- Clark's nutcracker (Nucifraga columbiana)
- Black-billed magpie (Pica pica)
- American crow (Corvus brachyrhynchos)
- Common raven (Corvus corax)

Titmice (Paridae)
- Black-capped chickadee (Parus atricapillus)
- Mountain chickadee (Parus gambeli)

Nuthatches (Sittidae)
- Red-breasted nuthatch (Sitta canadensis)
- White-breasted nuthatch (Sitta carolinensis)

Creepers (Certhiidae)
- Brown creeper (Certhia americana)

Wrens (Troglodytidae)
- Rock wren (Salpinctes obsoletus)
- House wren (Troglodytes aedon)
- Winter wren (Troglodytes troglodytes)

Dippers (Cinclidae)
- American dipper (Cinclus mexicanus)

Muscicapids (Muscicapidae)
- Golden-crowned kinglet (Regulus satrapa)
- Ruby-crowned kinglet (Regulus calendula)
- Western bluebird (Sialia currucoides) ↪ SWITCH
- Mountain bluebird (Sialia mexicana) ↩ SWITCH
- Townsend's solitaire (Myadestes townsendi)
- Swainson's thrush (Catharus minimus)
- Hermit thrush (Catharus guttatus)
- American robin (Turdus migratorius)
- Varied thrush (Ixoreus naevius)

Mockingbirds, thrashers (Mimidae)
- Gray catbird (Dumetella carolinensis)
- Sage thrasher (Oreoscoptes montanus)
- Brown thrasher (Toxostoma rufum)

Pipits (Motacillidae)
- Water pipit (Anthus spinoletta)

Table 5 (cont.). All birds recorded at Craters of the Moon National Monument to date.

Waxwings (Bombycillidae)
- Bohemian waxwing (Bombycilla garrulus)
- Cedar waxwing (Bombycilla cedrorum)

Shrikes (Laniidae)
- Northern shrike (Larus excubitor)
- Loggerhead shrike (Larus ludovicianus)

Starlings (Sturnidae)
- European starling (Sturnus vulgaris)

Vireos (Vireonidae)
- Solitary vireo (Vireo solitarius)
- Warbling vireo (Vireo gilvus)

Emberizids (Emberizidae)
- Tennessee warbler (Vermivora peregrina)
- Orange-crowned warbler (Vermivora celata)
- Nashville warbler (Vermivora ruficapilla)
- Yellow warbler (Dendroica petechia)
- Yellow-rumped warbler (Dendroica coronata)
- Townsend's warbler (Dendroica townsendi)
- American redstart (Setophaga ruticilla)
- Northern waterthrush (Seiurus noveboracensis)
- MacGillivray's warbler (Oporornis tolmiei)
- Wilson's warbler (Wilsonia pusilla)
- Yellow-breasted chat (Icteria virens)
- Western tanager (Piranga ludoviciana)
- Black-headed grosbeak (Pheucticus melanocephalus)
- Lazuli bunting (Passerina amoena)
- Green-tailed towhee (Pipilo chlorurus)
- Rufous-sided towhee (Pipilo erythrophthalmus)
- Chipping sparrow (Spizella passerina)
- Brewer's sparrow (Spizella breweri)
- Vesper sparrow (Pooecetes gramineus)
- Lark sparrow (Chondestes grammacus)
- Black-throated sparrow (Amphispiza bilineata)
- Sage sparrow (Amphispiza belli)
- Savannah sparrow (Passerculus sandwichensis)
- Fox sparrow (Passerella iliaca)
- Song sparrow (Melospiza melodia)
- Lincoln's sparrow (Melospiza lincolnii)
- White-throated sparrow (Zonotrichia albicollis)
- Golden-crowned sparrow (Zonotrichia atricapilla)
- White-crowned sparrow (Zonotrichia leucophrys)
- Dark-eyed junco (Junco hyemalis)
- Snow bunting (Plectrophenax nivalis)
- Red-winged blackbird (Agelaius phoeniceus)
- Western meadowlark (Sturnella neglecta)
- Yellow-headed blackbird (Xanthocephalus xanthocephalus)
- Brewer's blackbird (Euphagus cyanocephalus)
- Brown-headed cowbird (Molothrus ater)
- Northern oriole (Icterus galbula)

Table 5 (cont.). All birds recorded at Craters of the Moon National Monument to date.

Finches (Fringillidae)
Rosy finch (*Leucosticte arctoa*)
Pine grosbeak (*Pinicola enucleator*)
Cassin's finch (*Carpodacus cassinii*)
Red crossbill (*Loxia curvirostra*)
Common redpoll (*Carduelis flammea*)
Pine siskin (*Carduelis pinus*)
American goldfinch (*Carduelis tristis*)
Evening grosbeak (*Coccothraustes vespertinus*)
Old World sparrows (Passeridae)
House sparrow (*Passer domesticus*) 148

Mammals

The mammal trapping and tracking detected 655 individuals of 16 different species. The number of different species detected at a single station ranged from 1 to 5 (see table 6). The number of species for a given habitat type ranged from 1 to 7 (see table 7).

The first night of trapping recorded the lowest total number of detections even though prebaiting took place for one night before the trapping. A total of 107 detections were made on the first night compared to 187, 195, and 166 on the second, third and fourth nights respectively. The first night accounted for 51 new species-station detections compared to 29, 13, and 7 for the next three nights consecutively.

Table 6. Mammals detected through trapping or at track stations at Craters of the Moon National Monument.

Shrews (Soricidae)
Dusky shrew (*Sorex monticulus*)
Vagrant shrew (*Sorex vagrans*)
Pikas (Ochotonidae)
Pika (*Ochotona princeps*)(*)
Hares and Rabbits (Leporidae)
Pygmy rabbit (*Brachylagus idahoensis*)
Squirrels (Sciuridae)
Least chipmunk (*Eutamias minimus*)
Yellow-pine chipmunk (*Eutamias amoenus*)(*)
Golden-mantled ground squirrel (*Spermophilus lateralis*)
Red squirrel (*Tamiasciurus hudsonicus*)
Heteromyids (Heteromyidae)
Great basin pocket mouse (*Perognathus parvus*)(*)
Mice and Rats (Cricetidae)
Deer mouse (*Peromyscus maniculatus*)
Bushy-tailed woodrat (*Neotoma cinerea*)
Montane vole (*Microtus montanus*)
Long-tailed vole (*Microtus longicaudus*)
Canids (Canidae)
Coyote (*Canis latrans*)
Red fox (*Vulpes vulpes*)
Mustelids (Mustelidae)
Long-tailed weasel (*Mustela frenata*)

(*) Indicates species with subspecies endemic to the Craters of the Moon Area.

The percent success as measured by the number of individuals trapped or detected (track plates) per trap (or track plate) per night varied from a low of 2.7% for the vole traps to 31.53% for the large sherman traps (see table 8). The pitfall traps were the only traps to sample either species of *Sorex*. The larger, havahart traps were the only traps to detect pika, bushy-tailed woodrat, golden-mantled ground squirrel, red squirrel and pygmy rabbit. The track plates showed presence of red fox and coyote.

Table 7. Numbers of species detected in each vegetation type during mammal trapping and tracking.

Vegetation type	# species detected station 1	station 2	total
1	1	1	1
2	3	2	3
3	4	4	5
4	3	5	5
5	3	2	3
6	1	3	3
8	2	2	2
11	1	2	2
13	4	3	4
16	3	1	3
17	3	4	5
21	5	5	7
22	5	3	5
23	3	3	4
24	3	2	3
25	2	3	3
26	4	5	5

Table 8. Comparison of trapping success for each type of trap used.

trap type	detections	trap-nights	success ratio
pitfall[1]	13	448	0.0290
large sherman	343	1088	0.3153
small sherman	212	1088	0.1949
vole	19	680	0.0279
havahart	63	544	0.1158
track plates	5	272	0.0184
TOTALS	655	4120	0.1590

1) pitfalls could not be installed at 6 stations: 2.1, 3.1, 3.2, 11.2, 13.1, 13.2.

In addition to the censuses, casual observations brought the number of mammal species (with recent records) on the monument to 43 (see table 9).

Table 9. All mammals recorded at Craters of the Moon National Monument to date.

Shrews (Soricidae)
Dusky shrew (*Sorex monticulus*)
Vagrant shrew (*Sorex vagrans*)
Vespertilionid Bats (Vespertilionidae)
Little brown bat (*Myotis lucifugus*)
Long-eared bat (*Myotis evotis*)
Small-footed myotis (*Myotis leibii*)
Hoary bat (*Lasiurus cinereus*)
Townsend's big-eared bat (*Plecotus townsendii*)
Pikas (Ochotonidae)
Pika (*Ochotona princeps*)
Hares and Rabbits (Leporidae)
Pygmy rabbit (*Brachylagus idahoensis*)
Nuttall's cottontail (*Sylvilagus nuttalli*)
Snowshoe hare (*Lepus americanus*)
White-tailed jackrabbit (*Lepus townsendii*)
Black-tailed jackrabbit (*Lepus californicus*)
Squirrels (Sciuridae)
Least chipmunk (*Eutamias minimus*)
Yellow-pine chipmunk (*Eutamias amoenus*)
Yellow-bellied marmot (*Marmota flaviventris*)
Columbian ground squirrel (*Spermophilus columbianus*)
Golden-mantled ground squirrel (*Spermophilus lateralis*)
Red squirrel (*Tamiasciurus hudsonicus*)
Heteromyids (Heteromyidae)
Northern pocket gopher (*Thomomys talpoides*)
Great basin pocket mouse (*Perognathus parvus*)
Beavers (Castoridae)
Beaver (*Castor canadensis*)
Mice and Rats (Cricetidae)
Western harvest mouse (*Reithrodontomys megalotis*)
Deer mouse (*Peromyscus maniculatus*)
Bushy-tailed woodrat (*Neotoma cinerea*)
Montane vole (*Microtus montanus*)
Long-tailed vole (*Microtus longicaudus*)
Muskrat (*Ondatra zibethicus*)
Jumping mice (Zapodidae)
Western jumping mouse (*Zapus princeps*)
New World Porcupines (Erethizontidae)
Porcupine (*Erethizon dorastum*)
Canids (Canidae)
Coyote (*Canis latrans*)
Red fox (*Vulpes vulpes*)
Kit fox (*Vulpes macrotis*) (E)
Bears (Ursidae)
Black bear (*Ursus americanus*)
Grizzly bear (*Ursus arctos*) (E)
Procyonids (Procyonidae)
Raccoon (*Procyon lotor*)
Mustelids (Mustelidae)
Long-tailed weasel (*Mustela frenata*)

Table 9 (cont.). All mammals recorded at Craters of the Moon National Monument to date.

Mustelids (Mustelidae) (cont.)
Badger (*Taxidea taxus*)
Striped skunk (*Mephitis mephitis*)
Cats (Felidae)
Mountain lion (*Felis concolor*)
Lynx (*Felis lynx*) (E)
Bobcat (*Felis rufus*)
Cervids (Cervidae)
Elk (*Cervus elaphus*)
Mule deer (*Odocoileus hemionus*)
Pronghorn (Antilocapridae)
Pronghorn (*Antilocapra americana*)
Bovids (Bovidae)
Bison (*Bison bison*) (E)
Mountain Sheep (*Ovis canadensis*) (E) 47+E 42-

(E) Species for which there is historical evidence but no longer present on the monument.

DISCUSSION

Amphibians and Reptiles

Both amphibian species were found in the northern portions of the monument where free water was available. *Bufo borealis* (western toad) is probably the only amphibian to be expected on the monument. The few specimens of *Pseudacris triseriata* (boreal chorus frog), found in the residential area, were most likely inadvertently brought to the monument with firewood hauled from more typical habitat for this species. The reptiles were widely scattered with the exception of the western terrestrial garter snake which was only found along Little Cottonwood Creek.

Birds

The species richness (number of species) and diversity varied greatly between sampled vegetation types. The more structurally complex

vegetation types (riparian, aspen, limber pine and Douglas fir communities) on the whole, had greater species richness and diversity (see table 10 and figure 6).

Table 10. A comparison of bird diversity for each sampled vegetation type.

Vegetation type	Species Richness	Diversity (H')
1	4	1.2770
2	12	1.9031
3	12	1.8583
4	15	2.2046
5	13	2.2133
6	14	1.9490
8	13	2.1134
11	16	2.4187
13	14	2.1728
16	14	1.9441
17	11	1.9083
21	20	2.7601
22	20	2.4757
23	26	2.8074
24	34	3.1026
25	25	2.8439
26	26	2.9993

Mammals

Neither the species richness nor the diversity varied between sampled vegetation types to the extent that was shown with the birds, however, trends are still apparent (see table 11 and figure 7). The most diverse vegetation types with respect to birds was not necessarily the most diverse for mammals. On the contrary, it was often the opposite (see figure 8). The diversity of small mammals appears to be dependent on the productivity of the various vegetation types. Bird diversity on the other hand appears more closely linked to structural diversity of the plant communities.

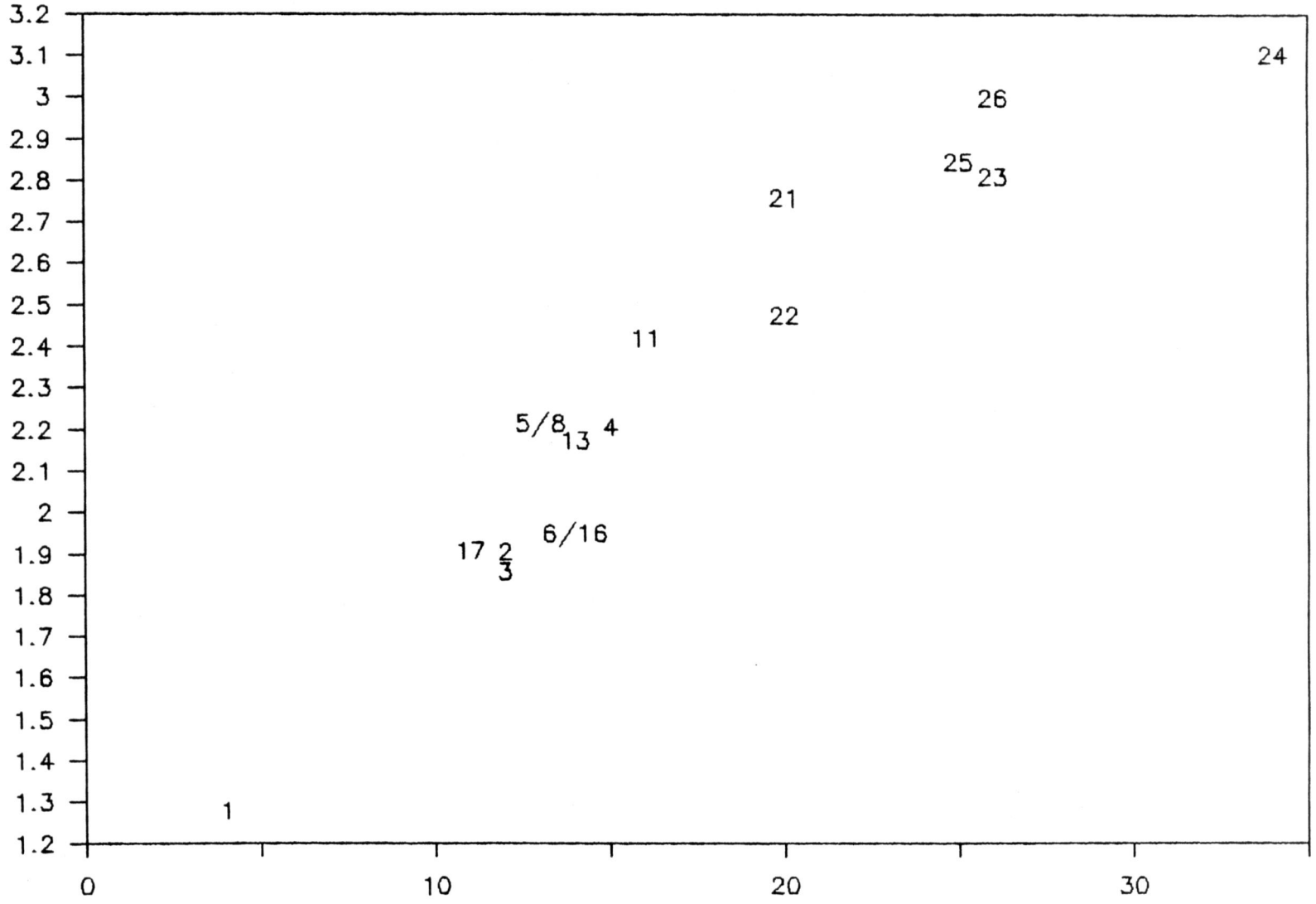


Figure 6. Avian species richness (horizontal axis) and diversity estimate (Shannon-Weaver) (vertical axis) for each vegetation type sampled. Numbers refer to the vegetation type as listed in Table 1.

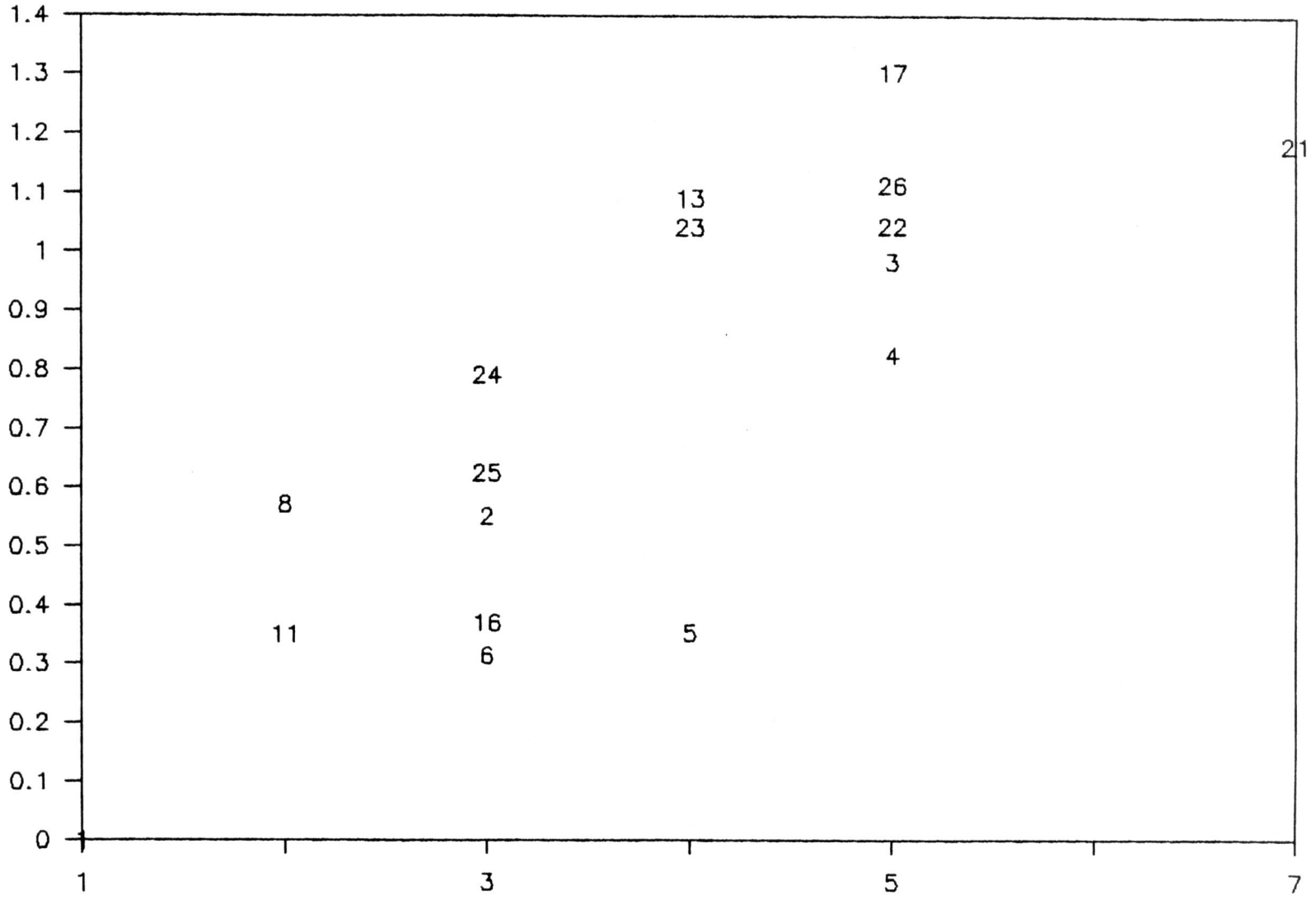


Figure 7. Mammalian species richness (horizontal axis) and diversity estimate (Shannon-Weaver) (vertical axis) for each vegetation type sampled. Numbers refer to the vegetation type as listed in Table 1.

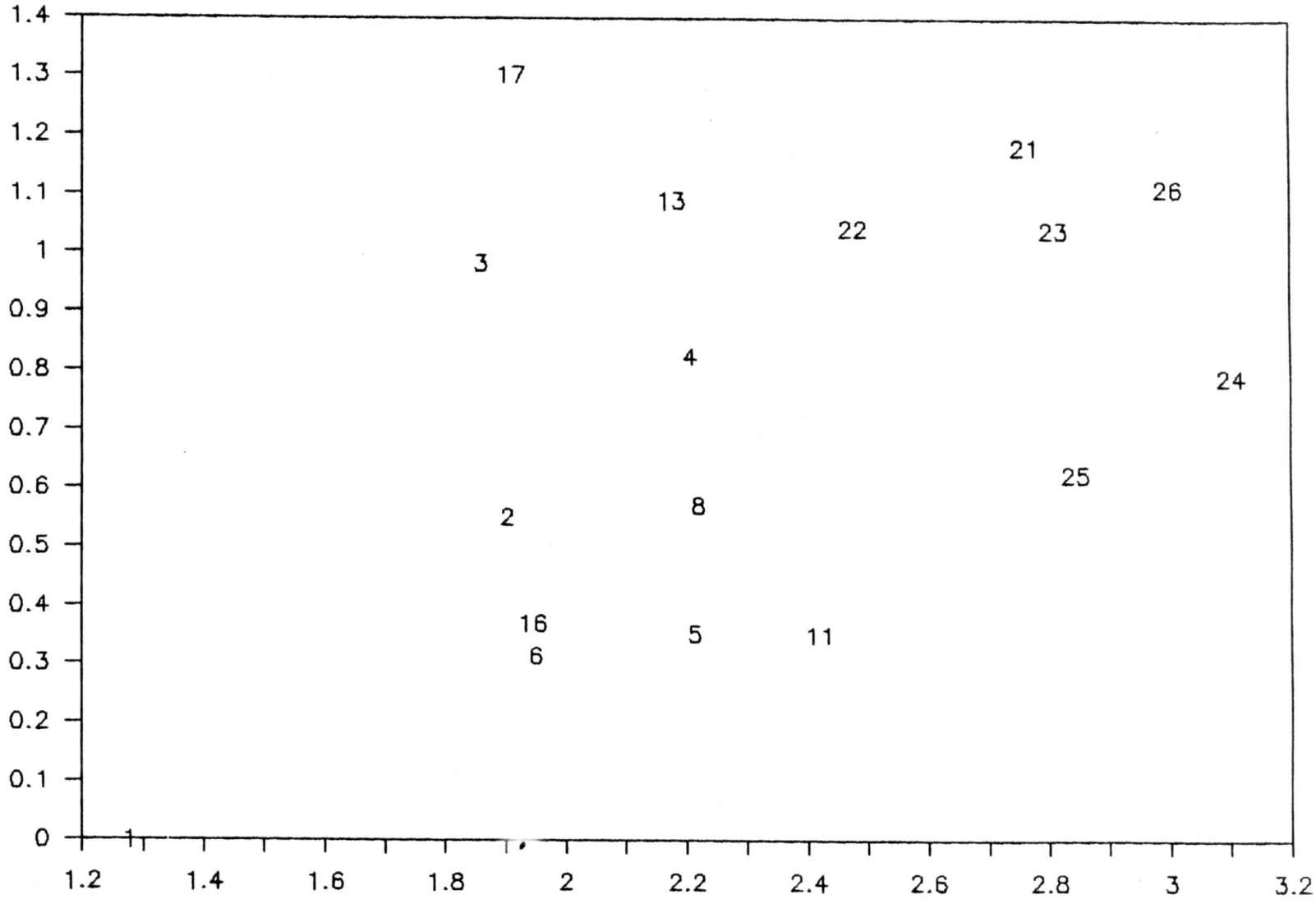


Figure 8. Avian and mammalian species diversity estimate (Shannon-Weaver) for each vegetation type sampled. Numbers refer to the vegetation type as listed in Table 1.

Table 11. A comparison of mammal diversity for each sampled vegetation type.

Vegetation type	Species Richness	Diversity (H')
1	1	0.0000
2	3	0.5504
3	5	0.9830
4	5	0.8232
5	4	0.3526
6	3	0.3144
8	2	0.5729
11	2	0.3488
13	4	1.0906
16	3	0.3698
17	5	1.3034
21	7	1.1823
22	5	1.0441
23	4	1.0420
24	3	0.7903
25	3	0.6240
26	5	1.1121

Many species were not well sampled, for example, the uncommon and solitary hoary bat roosts in the foliage of trees and was not found although it may be present on the monument (Shump and Shump 1982).

DATA STORAGE AND RETRIEVAL

The observations collected through trapping, tracking, censusing and though casual observations were filed in a computer system designed specifically for this study.

The system used dBASE III+ for storage of the information, pascal routines were used for mapping and plotting data. This allowed for the easy storage and retrieval of data including species identification, number of individuals, date, location, habitat type, observer, and status. This information was looked at in a number of ways. Maps based on the utm[1] coordinate system were generated for each species indicating

1. Utm refers to the universal transverse mercator grid, a worldwide system used to locate points on the earth's surface. The utm grid is indicated on all recent USGS topographic maps. The grid system is based on a series of

the species' status in each one km grid square. Seasonal distributions could also be plotted for each species or groups of species. Species lists could be generated for any criteria, such as habitat type, season, or combinations of these criteria. For more information on the capabilities of this computer system consult the system manual (Hoffman 1988).

IMPLICATIONS FOR MANAGEMENT

Large-scale Monitoring

Species Diversity

The use of species diversity is important in assessing the biological value, richness, uniqueness, and health of an area (Shaw, 1985). Because of their high positions in the food web, the diversity of animals in an area can be used to gauge the health of not only the animal communities but also the plant communities that they depend upon and ultimately the health of the entire ecosystem. Mammals, because of their secretive habits and the difficulty in capturing them, do not lend themselves to adequate sampling with respect to community diversity. In contrast, birds are conspicuous, readily identified and present in adequate numbers for statistical analysis to be performed on the samples (Mannan and Meslow 1981, Shaw 1985). Therefore it is recommended that bird diversity be used as an indicator of the health of the various habitat communities.

Birds, more than any other group of animals, have been used as indicators of environmental quality or community diversity and in

---

north - south zones extending around the world. Each zone covers 6° of longitude. In the northern hemisphere, a location is identified as the distance in meters east of a given zone boundary and by meters north of the equator. CRMO is in zone 12 with zone boundary the 114° longitude line.

monitoring change in an environment (Morrison, 1986). Because of their sensitivity, birds have been used to detect and monitor the effects of environmental contaminants that may have otherwise gone undetected by other measurement techniques (Carson 1962, Grue et al. 1983, Morrison 1986).

The techniques used in this study should be repeated annually in as many different vegetation types as personnel availability permit. In determining which vegetation types to sample, the following priority list should be consulted. These priorities are based on the sensitivity of each vegetation type and the significance of each with respect to the monument.

The riparian and aspen are by far the most important areas to monitor. They are sensitive to atmospheric pollutants, and are in isolated patches. Similar areas outside of the monument (such as Big Cottonwood Canyon and South Lava Creek) are at risk because of possible development including natural gas exploration and mining. The loss of riparian and aspen in adjacent lands would further isolate those areas on the monument and it is possible that this isolation would reduce the number of species able to utilize the remaining habitat even if protected on the monument. Reductions in the number of species using the riparian or aspen (or any habitat) would reduce the species diversity and hence should be detected through this monitoring system.

Each vegetation type should be sampled at two plots using the station index technique described above. The sampling effort (number of days and time each day) should be kept constant. The person doing the censusing should become familiar with the birds of the area (from the

species lists accompanying this report) in the field. This familiarity should include the ability to identify each species by sight and sound.

Priorities for sampling each vegetation type based on each type's vulnerability to external threats and the uniqueness of each type in the area.

Priority	Vegetation type
1	Riparian
2	Upland Quaking Aspen
3	Limber Pine/Antelope Bitterbrush (high density Limber Pine)
4	Limber Pine/Antelope Bitterbrush (high total cover)
5	Pine/Antelope Bitterbrush (low total cover)
6	Douglas-Fir/Mountain Snowberry
7	Mountain Big Sagebrush/Sandberg Bluegrass
8	Mountain Big Sagebrush/Bluebunch Wheatgrass
9	Antelope Bitterbrush
10	Mountain Big Sagebrush/Needle Grass
11	Low Sagebrush/Sandberg Bluegrass
12	Mountain Big Sagebrush/Idaho Fescue
13	Antelope Bitterbrush/Great Basin Wildrye
14	Three-tip Sagebrush/Idaho Fescue
15	Medium Density Lava Flows
16	Low Density Lava Flows
17	Cinder Gardens

Atlasing

Using techniques similar to the breeding bird atlas programs of many states and countries (Laughlin et al. 1982), an atlas of breeding birds could be used for long-term monitoring of the bird diversity and health of the bird communities. This project would require a systematic attempt at determining the breeding status of each species of bird in each grid cell being sampled (all may be sampled or only random cells depending on the number of cells and the available investment in time). The first stage of this project would be to complete an atlas in a five-year period. This would be considered a single point in time. This effort could then be repeated (over another five year period) in the future and the results compared. Trends in total numbers of breeding

species as well as changes in their breeding distributions may indicate changes in the environment either through natural succession of plant communities or though unnatural disturbance of their environment.

Specific species monitoring

Indicator or keystone species

Although their status in Idaho is unknown, loggerhead shrikes are known to be declining throughout their range. They have been identified as an indicator species by the U. S. Fish and Wildlife Service (Tate 1986). One explanation for their decline is chemical contamination. Because of their high position in the food chain, environmental toxins accumulate in their systems and the effects of these toxins are manifest earlier in this species than in prey species. Climatic changes and loss of nesting trees are also possible explanations.

Threatened, endangered and sensitive species

While there are no threatened or endangered species on the monument, eight species of birds present are believed to be declining over this part of their range: short-eared owl, black-throated sparrow, black-billed magpie, ferruginous hawk, yellow-breasted chat, merlin, western wood-pewee, and chipping sparrow. Three species classified as sensitive are present on the monument: Swainson's hawk, Lewis' woodpecker and loggerhead shrike. Swainson's and ferruginous hawks are category 2 species which are species that appear appropriate to propose as threatened or endangered but for which conclusive data on biological vulnerability and threat are not currently available to support proposed rules.

The decline of the black-billed magpie in the Pacific Northwest has been linked to the magpies' habit of feeding on the carcasses of dead

livestock (Henny et al. 1985). Livestock treated with famphur (an organophosphate pesticide to control cattle warbles) or other such pesticides have residues in their hair that the magpie ingests while feeding on the carcass.

Swainson's hawk is believed to be increasing in Idaho. The status of Lewis' woodpecker in Idaho is unknown. Elsewhere populations are showing significant declines due to loss of riparian habitat and competition with starlings for nesting cavities.

The yellow warbler was once on the sensitive species list due to loss of riparian habitat and cowbird parasitism. However, further analysis shows slight increases in the Northwest. The true status of this species deserves further attention.

While no threatened or endangered mammals occur on the monument, it is worth noting that the Spotted Bat (Euderma maculatum) (possibly occurring on the monument) and a subspecies of Townsend's Western big-eared bat of California, Washington and Oregon (Plecotus townsendii townsendii) are category 2 species as described above.

Exotic birds

The monument has four species of exotic birds present: European house sparrow, European starling, chukar, and gray partridge. While the presence of the two exotic game species is not of concern, the house sparrow and the starling present more serious management implications. At present, neither species is very common. However, both species compete with native species for nesting cavities and both are becoming more numerous in the region. Widespread declines in the number of such cavity nesters as swallows, woodpeckers and bluebirds have been linked to the invasion of these exotic competitors.

It is possible that control of these species could prevent colonies from becoming established in the monument. It is not known how intense the control efforts need be to be effective. Trapping or shooting each starling and house sparrow seen on the monument during and just prior to the nesting season (May and June) would keep these unwanted species from establishing nesting populations.

Bats

Little brown bats (Myotis lucifugus) and Townsend's big-eared bat (Plecotus townsendii) hibernate in suitable sites throughout their range (Fenton and Barclay 1980, Genter 1986, Kunz and Martin 1982). Water balance is very important to the survival of the small bat species especially during the long period of hibernation (Proctor and Studier, 1970). Because of the cold, dry conditions in the winter, it is unlikely that either of these small bat species could successfully hibernate on the monument. The only species found on the monument in the winter is the small-footed myotis (Myotis leibii) found in Arco tunnel. This species is more tolerant to the marginal conditions of this area (Genter 1986).

The vulnerability of all bats (including Townsend's big-eared bat) is high due to the susceptibility of disturbance (Barbour and Davis 1969, Graham 1966, Humphrey and Kunz 1976). Disturbance on hibernating bats causes weight loss thus decreasing their probability of survival (Fenton and Barclay 1980). Townsend's big-eared bats are known to desert preferred roosts when disturbed by the presence of people (Humphrey and Kunz 1976). Nursery populations have also been shown to decline after disturbance without recovery the following year. It is believed that due to the low margin of fat reserves in spring, that repeated disturbance of

Townsend's big-eared bats could lead to increased winter mortality (Humphrey and Kunz 1976).

All caves being identified as hibernacula or used by nursery groups should be given special protection from disturbance. Visitors to Arco tunnel (a known hibernacula) during the winter months should be instructed to avoid disturbing the bats. Nursery groups in the caves of the north end (such as 'Chimney Cave' on the Grassy Cone Flow) are probably not in danger of repeated disturbance because of the limited use of the area.

Activities that significantly increase the amount of light, heat or air movement all constitute a disturbance to hibernating bats. Handling or arousing of bats during hibernation will most likely be fatal to those individuals because they awaken from hibernation very rapidly and this will take a great deal of energy. Also, the stirring of one bat will awaken others nearby. Because of the higher level of awareness of roosting bats or bats in maternity colonies, an entry into areas of the caves used by bats during this time of the year (May and June) is considered a disturbance. It takes few such disturbances to cause a maternity colony to abandon the site for a possibly less favorable site.

Porcupine

The status of the porcupine on the monument has changed from common to nearly absent. No living porcupines were found during this study although evidence suggests that they are present in nearby areas and that they still occur infrequently on the monument.

During the early years of the monument, porcupine were occasionally destroyed. It is not known how many animals were killed or whether these control efforts were responsible for eliminating this species from the

monument. It is also possible that the reduction in the limber pine during the mistletoe control of the 1960's contributed to its disappearance.

Because anthropogenetic activities were probably responsible for the extirpation of the porcupine from the monument, reintroduction of this species should be considered.

Cavity nesting species

Mistletoe control of the early 1960's killed more than 6,000 limber pine. Many of these trees were killed by injection and left standing. These snags and those of natural origin, because of the dry environment of Craters of the Moon remain standing for many years. These standing snags provide an abundance of cavities for nesting birds. Many of the common breeding birds on the monument are cavity nesters, mountain bluebird, Lewis' woodpecker, northern flicker, black-capped and mountain chickadees, and violet-green swallow. With the decrease in the number of available limber pine snags through attrition and the decrease in the number of mature limber pine dying to create more cavities, the numbers of some of these cavity nesting species may decrease. However, some of these species (mountain bluebird, mountain chickadee and violet-green swallow) are known to use small lava-tubes and lava blisters as nesting cavities.

The Lewis' woodpecker will probably be the most affected by a reduction in the number of natural cavities. Although a few Lewis' woodpeckers have been known to nest in the limber pine, they are primarily a bird of the aspen and riparian areas. Because of this they are dependent on the aspen and cottonwood cavities for nesting. The majority of aspen in Little Cottonwood Canyon are too small to support a

nesting cavity. It is believed that this is in part due to the frequency of fire in the area, killing the aspen before maturity.

Grazing

Studies of the effects of sheep grazing on the abundance and diversity of the small mammal populations in a sagebrush habitat, found that the number of individuals, the number of species and the species diversity (H') were all lower on the grazed plots (187 vs 159, 9 vs 5, and 1.11 vs 0.69 respectively) (Reynolds 1980). It has also been demonstrated that grazing and browsing by domestic livestock can drastically alter the vegetation of an area, making it desirable for some species of birds and undesirable for others (Kirsch et al. 1978). Damage to vegetation by livestock has contributed to the decline of native birds while leading to increases in exotic and noxious species. Because of these findings, every attempt should be made to keep livestock from trespassing on the monument.

Topics for Further Research

Juniper communities

Late in the field season of 1987, a extensive stand of juniper was identified near Fissure Butte in the southern part of the wilderness area. Because of the unique bird and mammal communities normally associated with juniper, it would be interesting to investigate this area. Species such as plain titmouse and pinyon jay may be nesting there. If so, it would be a northern extension of the known breeding range for both species. The pinyon jay has been found in the northern portions of the monument occasionally in the fall suggesting that a post-breeding dispersal is taking place from the south. Also possible in the

area would be the pinyon mouse and greater likelihood of species such as kangaroo rats found on the deserts to the south of the monument.

Fox sparrows and song sparrows.

Early bird records from Little Cottonwood Canyon include many of the song sparrow. During this study, all sparrows of the genus Melospiza found in Little Cottonwood Canyon were the fox sparrow. These two species are very closely related and are known to displace each other especially in areas were the available habitat is quite limited as in Little Cottonwood Canyon. Has the fox sparrow displaced the song sparrow? If so is this a stable status or will this change over time. Or is it possible that the early identifications were incorrect?

The red fox and coyote

The red fox has been expanding its range throughout the west in association with agriculture. Only recently have they been seen with regularity on the monument. The coyote experiences heavy trapping and shooting (government and private) in areas surrounding the monument. It is not known what effect this "management" has on the coyote population but it is possible that due to decreased numbers of coyotes, the red fox has managed to coexist in the area.

Owls as rodent samplers and caves as traps

The pellets from owls, particularly those where the pellets are protected from the weather, such as in caves, can be useful for determining the presence of small mammal species. This analysis can also be extended to determine relative abundance of the prey species throughout the period of deposition, in some cases thousands of years (Guilday 1969). Owls are biased in what prey they capture, as are all trapping methods. Combinations can suggest more accurately, the relative

abundance especially of trap-shy species. In general, owls have been considered good collectors of small mammals and there have been new genera, new species and new distribution records described from material in owl pellets (Happold and Happold 1986). For example, the distribution of Merriam's shrew in Idaho has been documented in part by analysis of the remains of shrews found in Moonshine and Middle Butte caves (Mullican 1986).

At nearby Middle and Twin Buttes, lava blisters have been found to include the remains of pine martin, wolverine, ermine, least weasel and Canada lynx all suggestive of a prehistorically cooler climate. Of more recent origins in the same caves were grizzly bear, wolf, kit fox, marten, black-footed ferret, wolverine, wapiti, and bison (White et al. 1982).

LITERATURE CITED

Barbour, R. W., and W. H. Davis. 1969. Bats of America. Univ. Press, Kentucky, Lexington, 286 pp.

Barrett, R. H. 1983. Smoked aluminum track plots for determining furbearer distribution and relative abundance. Cal Fish and Game 69:188-190.

Blakesley, J., and R. Wright. 1988. A Review of Scientific Research at Craters of the Moon National Monument. College of Forestry, Wildlife and Range Sciences. Univ. Idaho. Station Bulletin No. 50. 42 pp.

Bury, R. B., and M. G. Raphael. 1983. Inventory methods for amphibians and reptiles. Pages 416-419 In J. F. Bell and T. Atterbury (eds.). Renewable resources inventories for monitoring changes and trends. College of Forestry, Oregon State University, Corvallis. 737 pp.

Buttrick, S. C. 1984. Biological monitoring: the nature conservancy's perspective, pp. 59-63 In Research natural areas: baseline monitoring and management. J. L. Johnson, J. F. Franklin, and R. G. Krebill, coordinators. Proc. of a Symposium in Missoula, Montana, March 21, 1984. Gen. Tech. Rep. INT-173. Ogden, UT: U.S.D.A. Forest service, Intermountain Forest and Range Experiment Station, 1984. 84pp.

Carson, R. 1962. Silent Spring. Houghton Mifflin, Boston.

Chitty, D., and D. A. Kempson. 1949. Prebaiting small mammals and a new design of live trap. Ecol. 30:536-542.

Clark, T. W., and T. M. Campbell. 1983. A small carnivore survey technique. Great Basin Nat. 43:438-440.

Day, T. A., and R. G. Wright. 1985. The vegetation types of Craters of the Moon National Monument. Forest, Wildlife and Range Experiment Sta. Bull. No. 38. Univ. of Idaho, Moscow. 6pp.

Despain, D., D. Houston, M. Meagher, and P. Schullery. 1986. Wildlife in Transition. Roberts Reinhart, Inc. Boulder, CO. 142pp.

Doucet, G. J., J. R. Bider, and W. L. Vickery. 1985. Sand-tracking as a technique to study nocturnal mammals, pp. 53 In Brooks, R. P. (ed.). Nocturnal mammals: techniques for study. School of Forest Resources, Research Paper No. 48. Penn. State Univ., University Park. vi+57pp.

Emlen, J. T. 1981. Summary of the symposium. Pages 575-576 In C. J. Ralph and J. M. Scott (eds.). Estimating numbers of terrestrial birds. Studies in avian biol., No. 6. Allen Press, Lawrence, KS. 630 pp.

Fenton, M. B., and R. M. R. Barclay. 1980. Myotis lucifugus. Mamm. Species, 142:1-8.

Garton, E. O. 1984. Cost-efficient baseline inventories of research natural areas, pp. 40-45 In Research natural areas: baseline monitoring and management. J. L. Johnson, J. F. Franklin, and R. G. Krebill, coordinators. Proc. of a Symposium in Missoula, Montana, March 21, 1984. Gen. Tech. Rep. INT-173. Ogden, UT: U.S.D.A. Forest service, Intermountain Forest and Range Experiment Station, 1984. 84pp.

Genter, D. L. 1986. Wintering bats of the upper snake river plain: occurrence in lava-tube caves. Great Basin Nat. 46:241-244.

Goetz, R. C. 1981. A photographic system for multiple automatic exposures under field conditions. J. Wildl. Manage. 45:273-276.

Graham, R. E. 1966. Observations on the roosting habits of the big-eared bat, Plecotus townsendii in California limestone caves. Cave Notes, 8:17-22.

Grue, C. E., W. J. Fleming, D. G. Busby, and E. F. Hill. 1983. Assessing hazards of organophosphate pesticides to wildlife, Trans. North Am. Wildl. and Natur. Resour. Conf. 48:200-220.

Guilday, J. E. 1969. Small mammal remains from the Wasden site (owl cave), Bonneville county, Idaho. Tebiwa 12:47-51.

Halvorson, C. H. 1984. Long-term monitoring of small vertebrates: a review with suggestions, pp. 11-25 In Research natural areas: baseline monitoring and management. J. L. Johnson, J. F. Franklin, and R. G. Krebill, coordinators. Proc. of a Symposium in Missoula, Montana, March 21, 1984. Gen. Tech. Rep. INT-173. Ogden, UT: U.S.D.A. Forest service, Intermountain Forest and Range Experiment Station, 1984. 84pp.

Happold, D. C. D., and M. Happold. 1986. Small mammals of Zomba Plateau, Malawi, as assessed by their presence in pellets of the grass owl, Tyto capensis, and by live-trapping. Afr. J. Ecol. 24:77-87.

Henny, C. J., L. J. Blus, E. J. Kolbe, and R. E. Fitzner. 1985. Organophosphate cattle pour-on insecticide (Famphur) kills Black-billed Magpies and Red-tailed Hawks. J. Wildl. Manage. 49:648-658.

Hinds, T. W. 1984. Towards Monitoring of Long-term Trends in Terrestrial Ecosystems. Environmental Conservation. 11:11-18.

Hoffman, R. A. 1988. The Craters of the Moon National Monument Wildlife Database: Operating Manual. USDI National Park Service Cooperative Park Studies Unit report B-88-3. 26pp.

Humphrey, S. R., and T. H. Kunz. 1976. Ecology of a Pleistocene relict, the western big-eared bat (Plecotus townsendii). J. Mamm. 57:470-494.

Kirsch, L. M., H. F. Duebbert, and A. D. Kruse. 1978. Grazing and haying effects on habitats of upland nesting birds. Trans. North Am. Wildl. and Natur. Resour. Conf. 43:486-497.

Kunz, T. H., and R. A. Martin. 1982. Plectus townsendii. Mammal. Species, 175:1-6.

Laughlin, S. B., D. P. Kibbe, and P. F. J. Eagles. 1982. Atlasing the distribution of the breeding birds of North America. American Birds 36:6-19.

Lord, R. D., A. M. Vilches, J. I. Maiztegui, and C. A. Soldini. 1970. The tracking board: a relative census technique for studying rodents. J. Mamm. 51:828-829.

Mack, A., W. P. Gregg. Jr., S. P. Bratton, and P. S. White. 1981. A survey of ecological inventory, monitoring and research in U. S. National Park Service Biosphere Reserves. U. S. Department of the Interior, National Park Service, NPS-SER Research/Resources Management Report No. 49. 23pp.

Mannan, R. W., and E. C. Meslow. 1981. Census techniques for nongame birds, pp. 181-196 In Miller, F. L., and A. Gunn (eds.). Symposium on census and inventory methods for population and habitats. Forest, Wildlife and Range Experiment Station, Univ. Idaho, Moscow, Idaho. Contribution No. 217.

Morrison, M. L. 1986. Bird populations as indicators of environmental change. Curr. Ornithol. 3:429-451.

Mullican, T. R. 1986. Additional records of Sorex merriami from Idaho. Murrelet. 67:19-20.

Proctor, J. W., and E. H. Studier. 1970. Effects of ambient temperature and water vapor pressure on evaporative water loss in Myotis lucifugus.

Raphael, M. G., and K. V. Rosenberg. 1983. An integrated approach to wildlife inventories in forested habitats, pp. 219-222 In Renewable resource inventories for monitoring changes and trends - An International Conf. Bell, S. F., and T. Attenberg (eds.). Oregon State Univ. College Forestry.

Raphael, M. G., and R. H. Barrett. 1981. Methodologies for a comprehensive wildlife survey and habitat analysis in old-growth Douglas-fir forests. Cal-Neva Wildl. Trans. 106-121.

Raphael, M. G., and R. H. Barrett. 1983. Diversity and abundance of wildlife in late successional Douglas-fir forests, In Transactions Society of American Foresters Convention, Portland OR.

APPENDIX

CALCULATION OF THE SHANNON-WEAVER ESTIMATE OF DIVERSITY

Consider the following sample results of censuses in one vegetation type:

	station 1			station 2		
	day 1	day 2	day 3	day 1	day 2	day 3
Mourning Dove	10	8	9	6	6	4
Vesper sparrow	4	6	5	8	7	7
Brewer's sparrow	3	2	2	3	4	4
Rufous-sided towhee	2	2	3	4	3	4
Green-tailed towhee	2	1	2	0	0	0

The formula for the Shannon-Weaver estimate of diversity is:

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

Where: H' is the Shannon-Weaver estimate of diversity.
S is the number of species.
p_i is the proportion of the total number of individuals consisting of the ith species.

P_i is intended to be the true proportion of each species in the population, however in practice, p_i is estimated by n_i/N where N is the total number of individuals detected and n_i is the number of individuals of species 1.

The combined species list and maximum counts of each species from both stations over all three days was used to calculate the diversity for each vegetation type sampled. The following species list and totals would be used in the calculations:

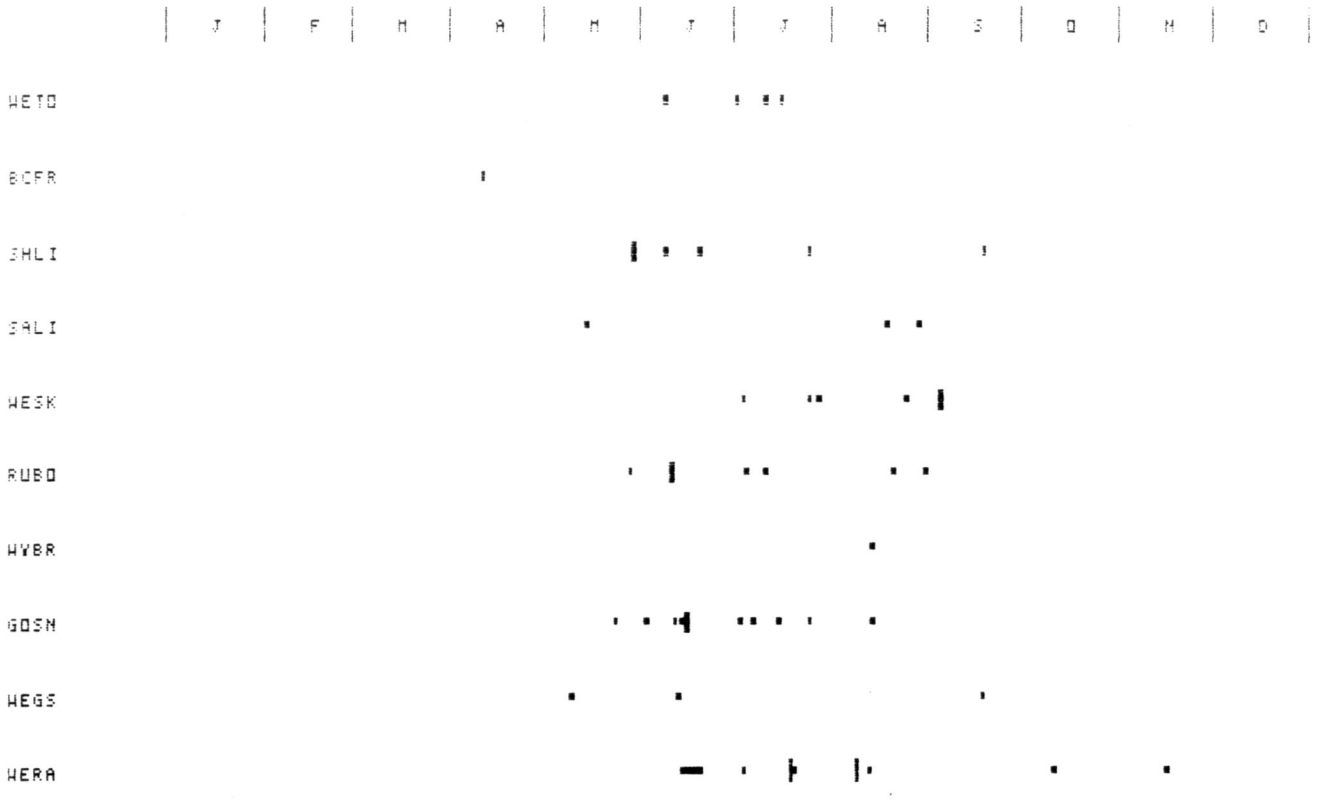
i Species	n_i	p_i
1: Mourning Dove	10	10/28 = 0.357
2: Vesper sparrow	8	8/28 = 0.286
3: Brewer's sparrow	4	4/28 = 0.143
4: Rufous-sided towhee	4	4/28 = 0.143
5: Green-tailed towhee	2	2/28 = 0.071
total: N =	28	

Therefore, the equation takes the form:

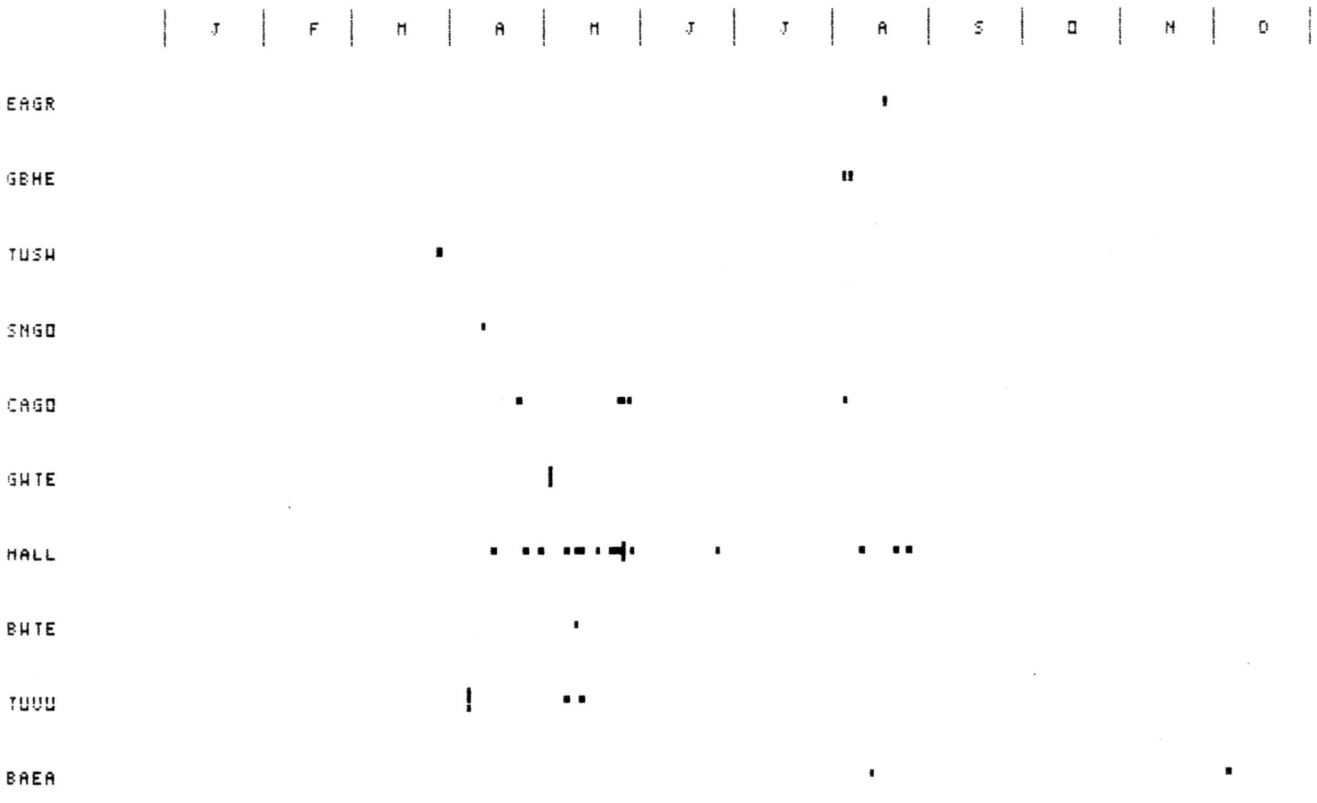
$$H' = -(0.357 \ln 0.357)+(0.286 \ln 0.286)+(0.143 \ln 0.143)+(0.143 \ln 0.143)+(0.071 \ln 0.071)$$

$$H' = 1.470$$

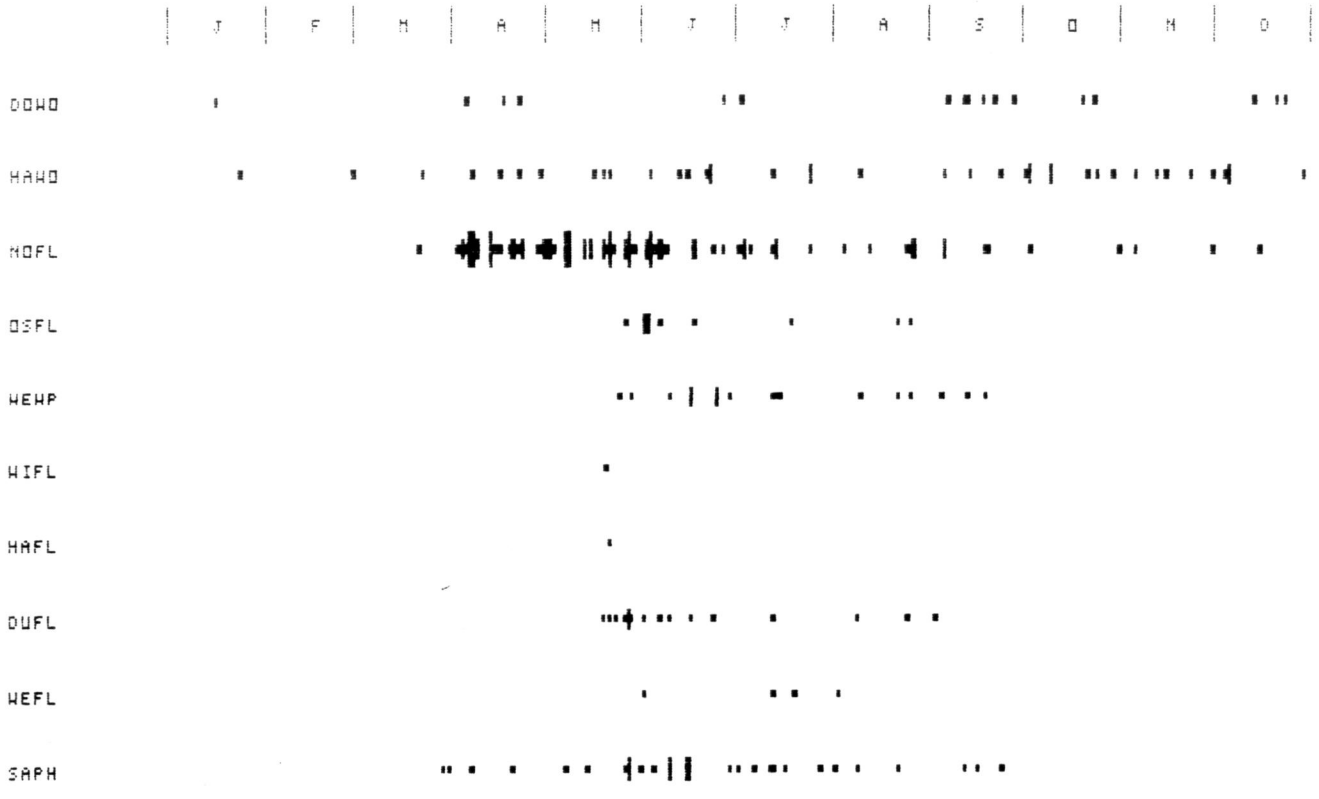
SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT



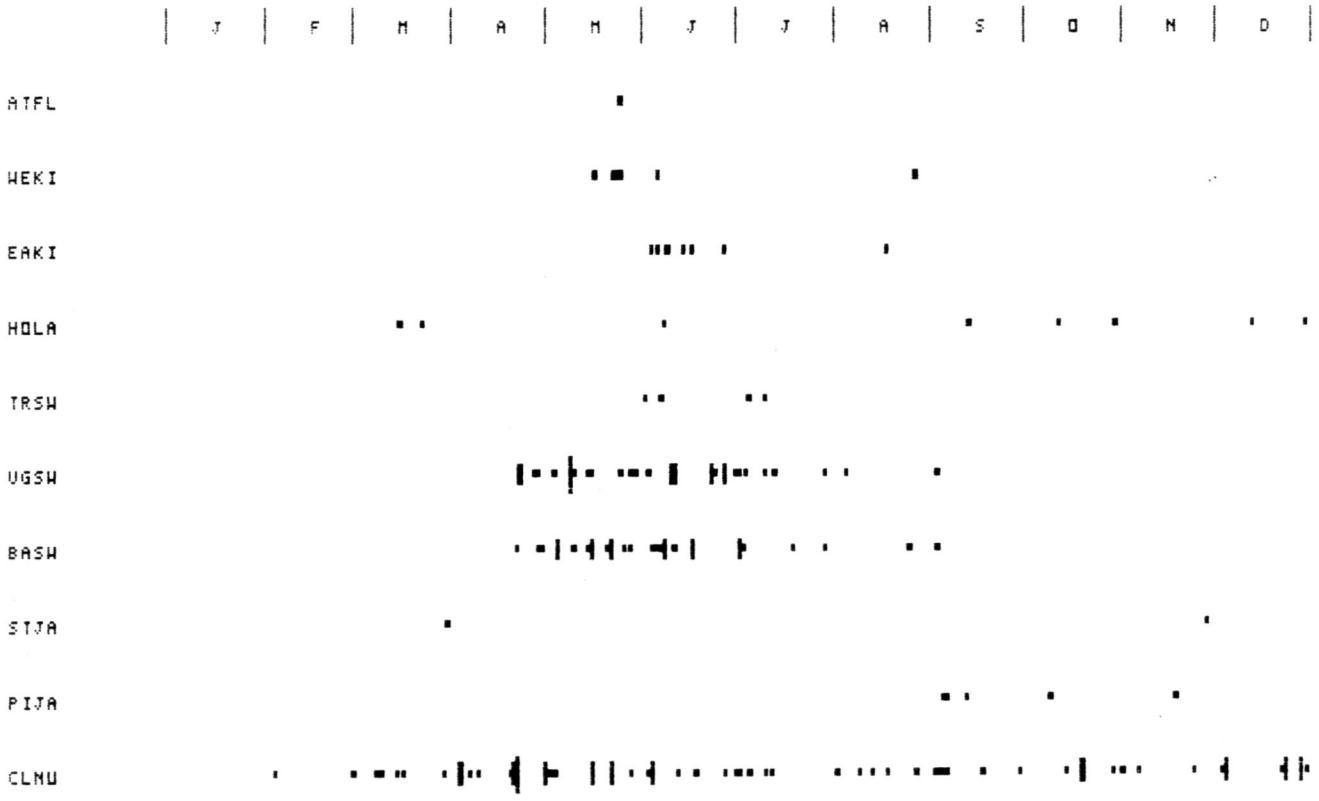
SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT



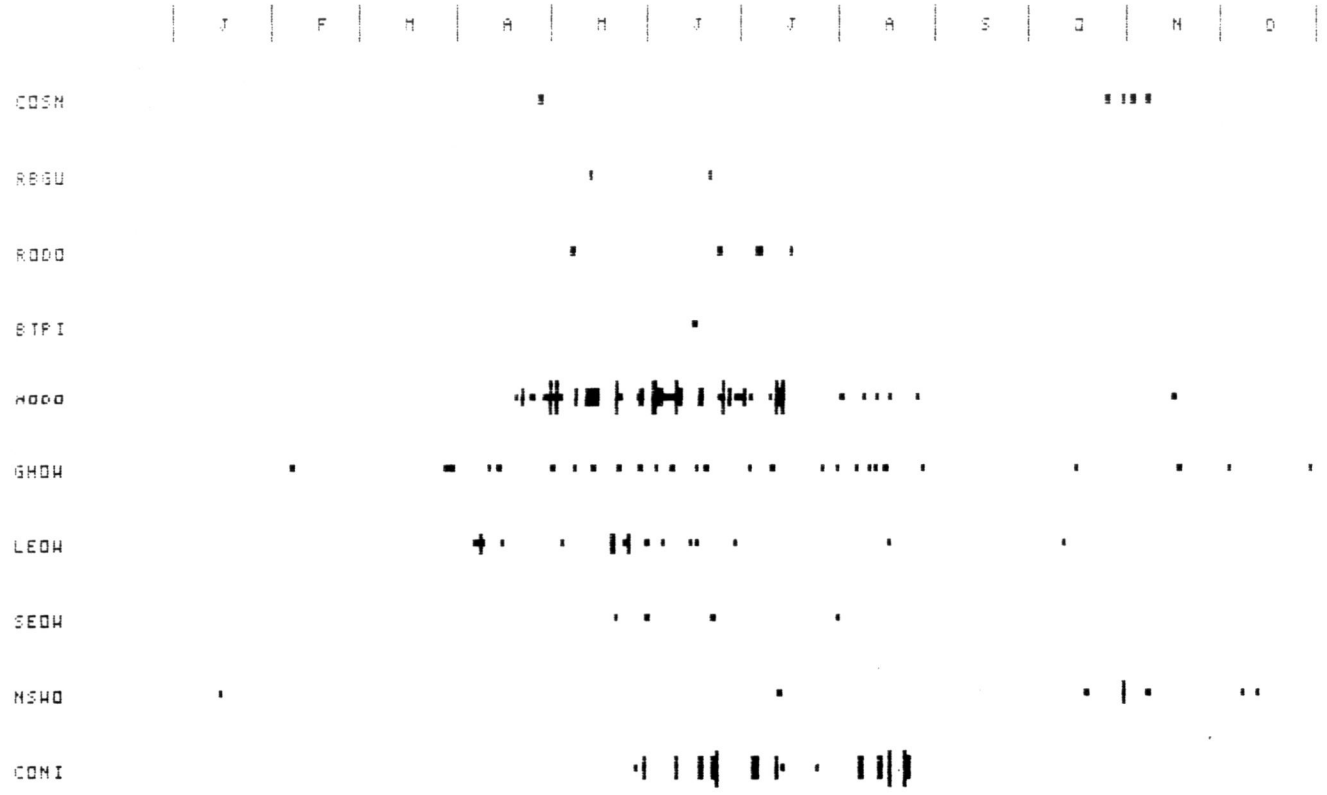
SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT



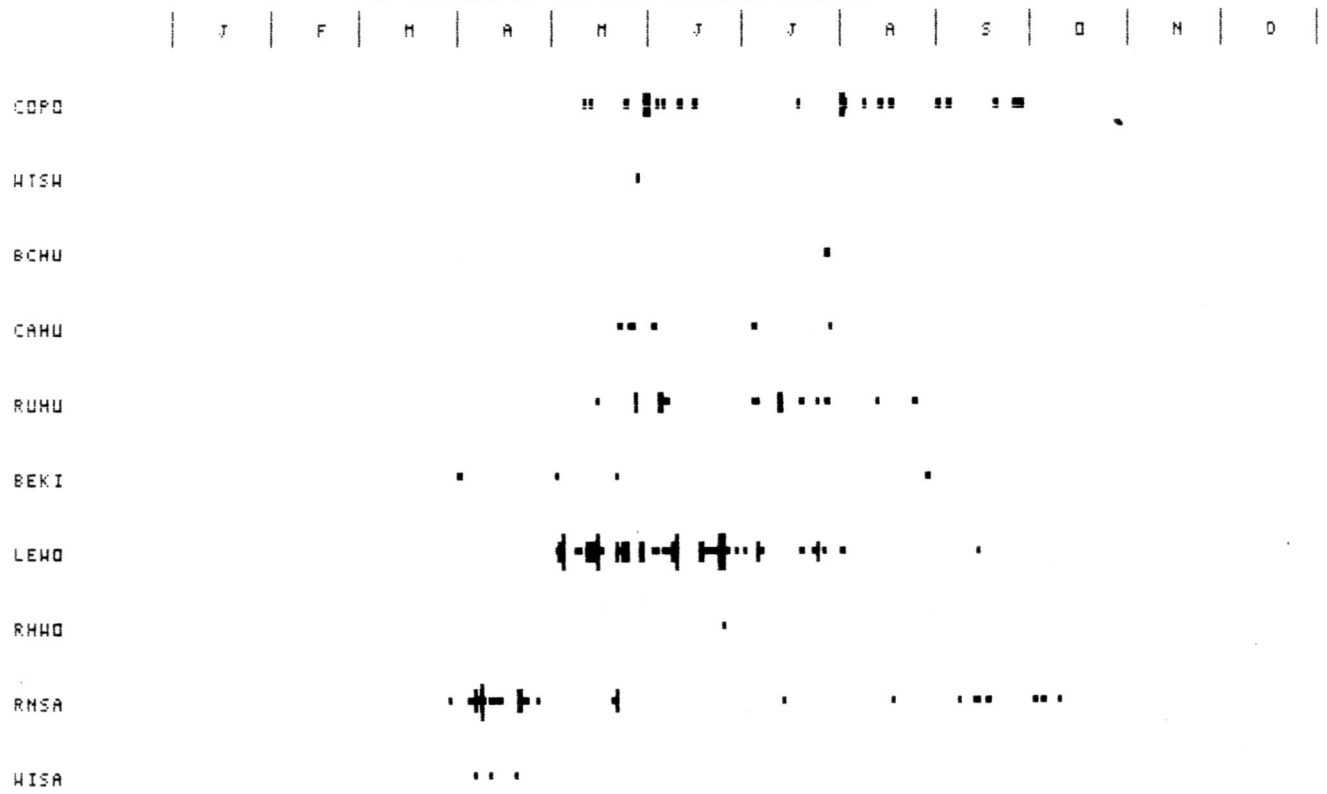
SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT



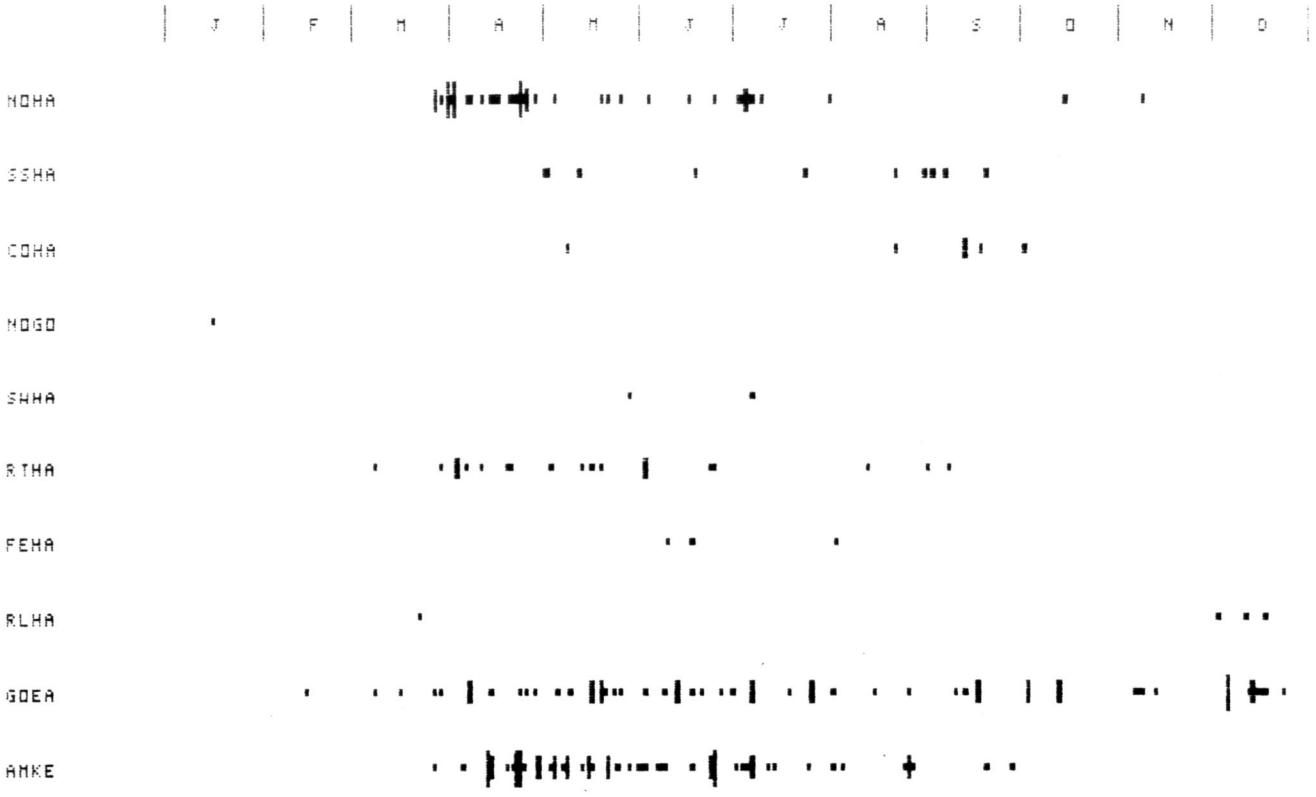
SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT



SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT



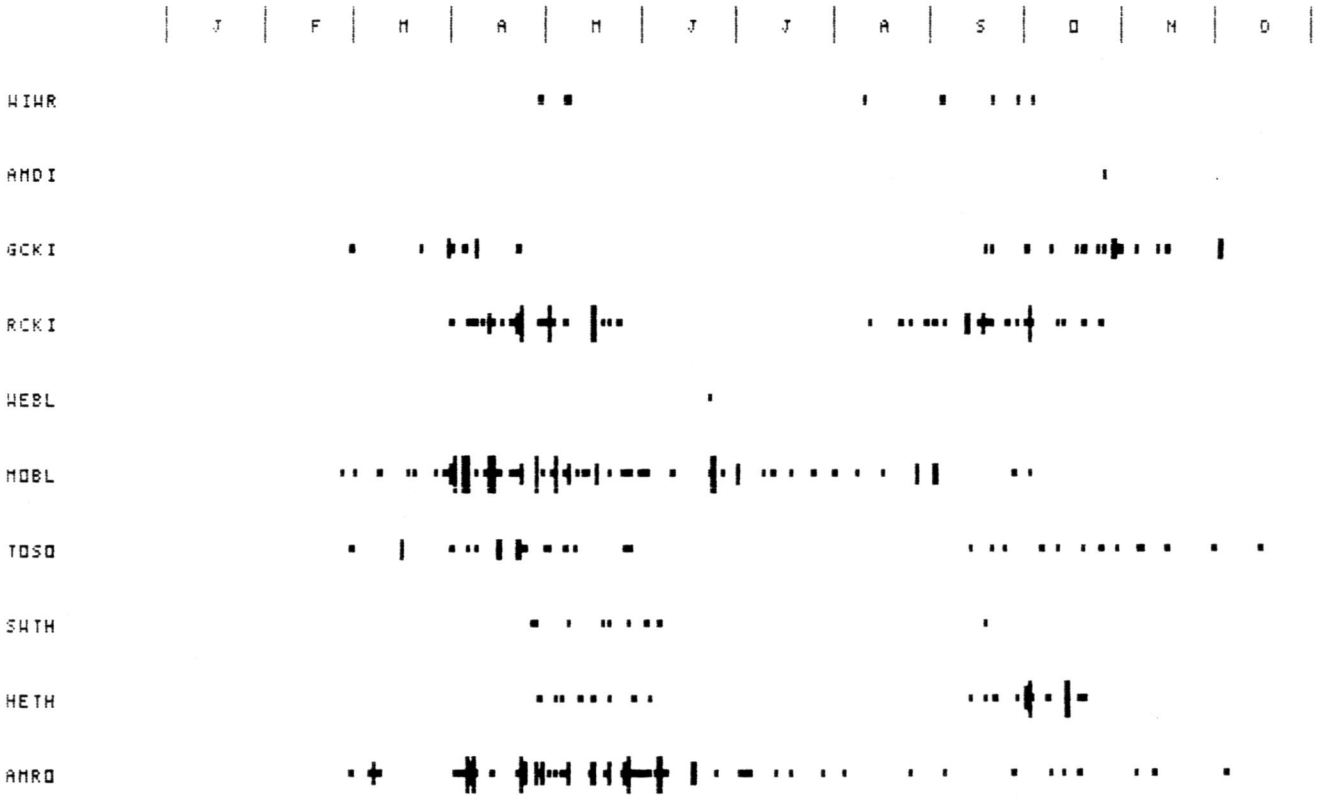
SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT



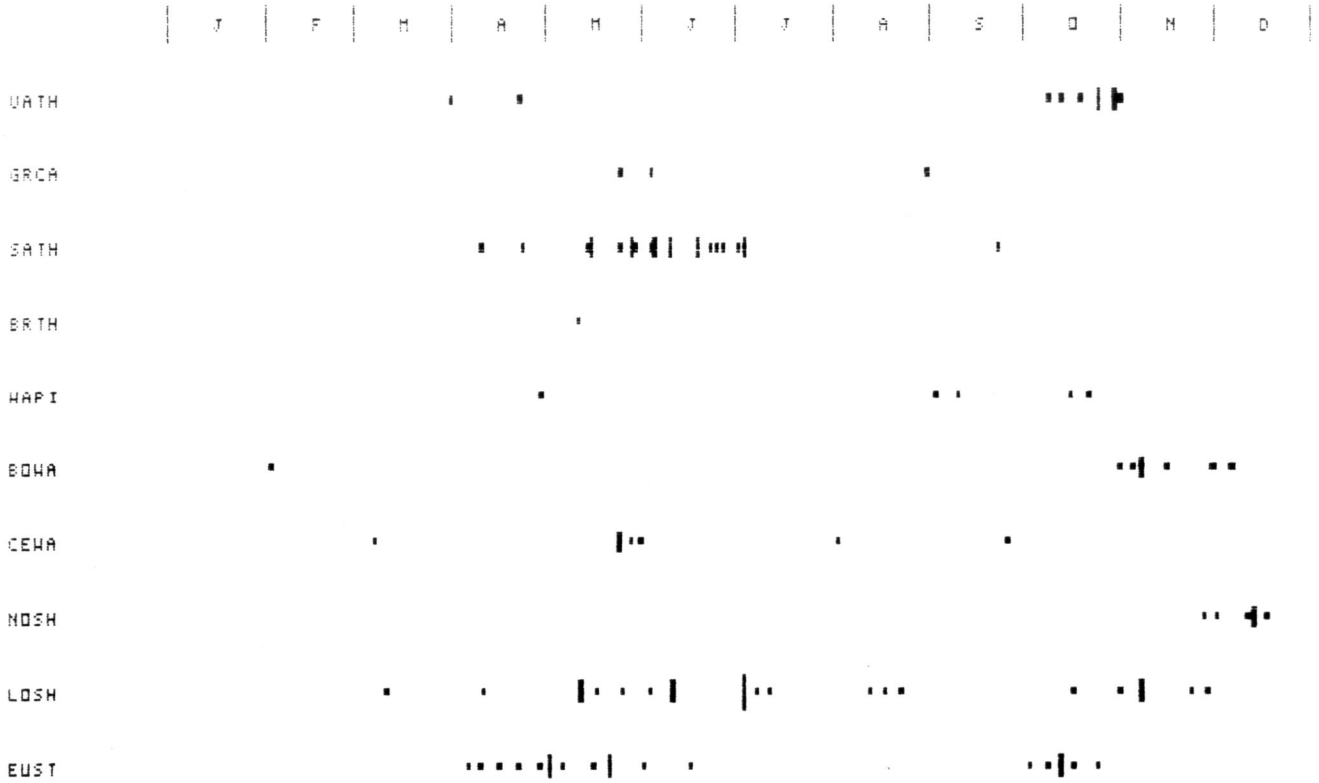
SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT

SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT

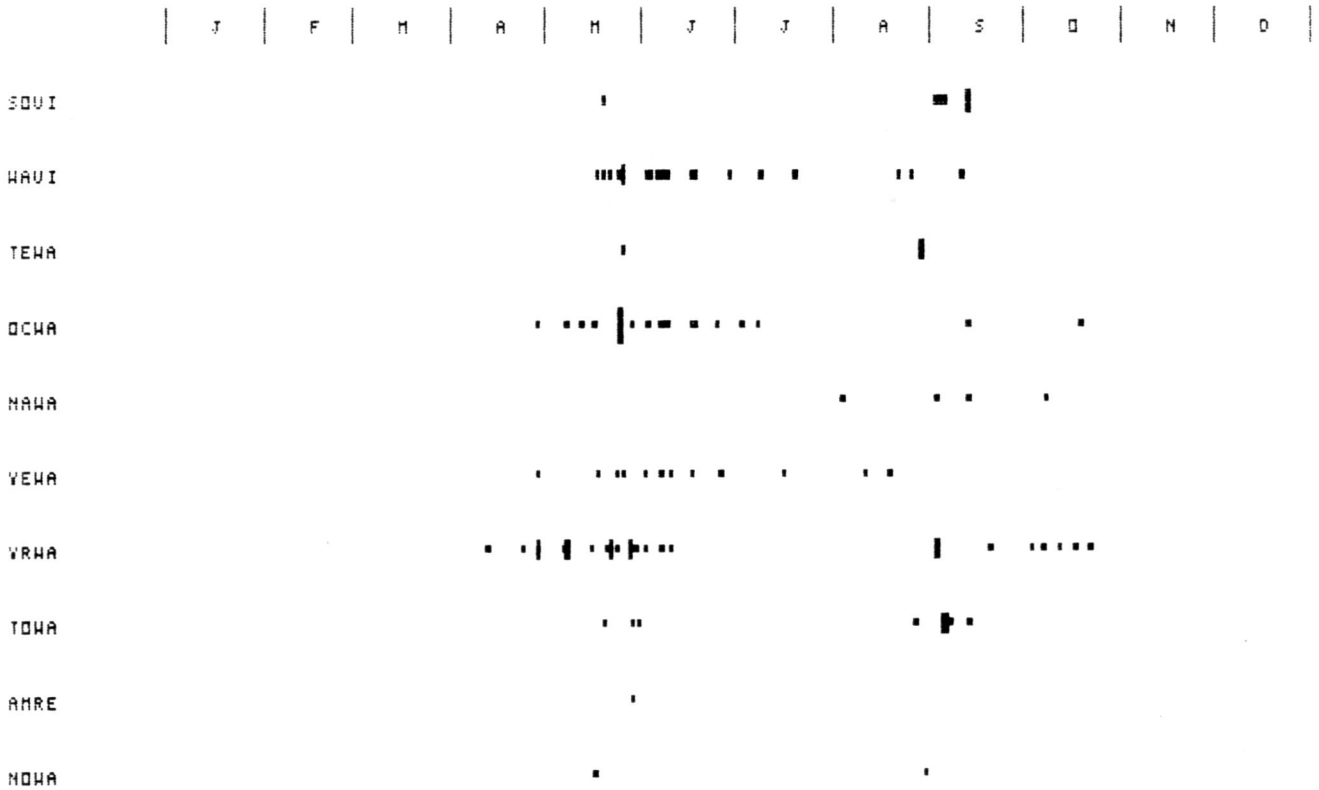
SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT



SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT

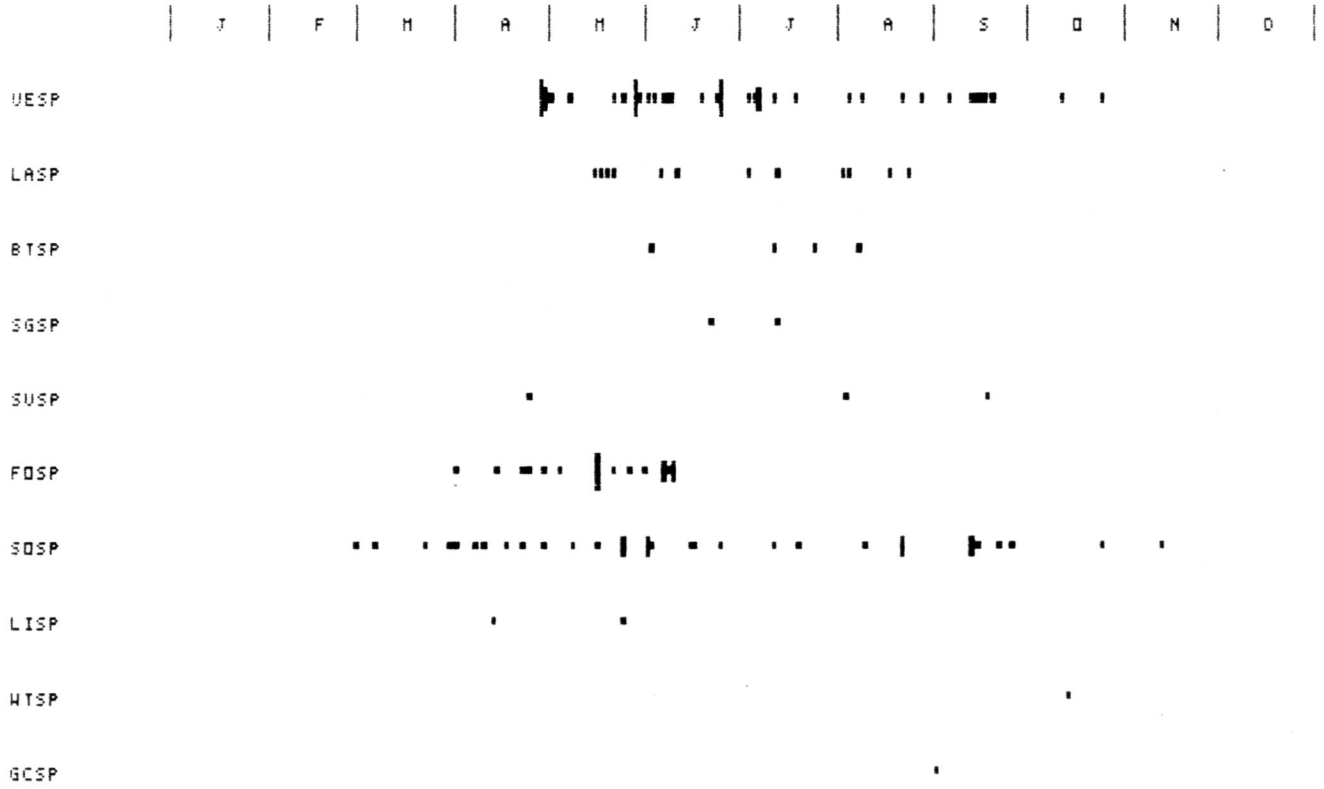


SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT

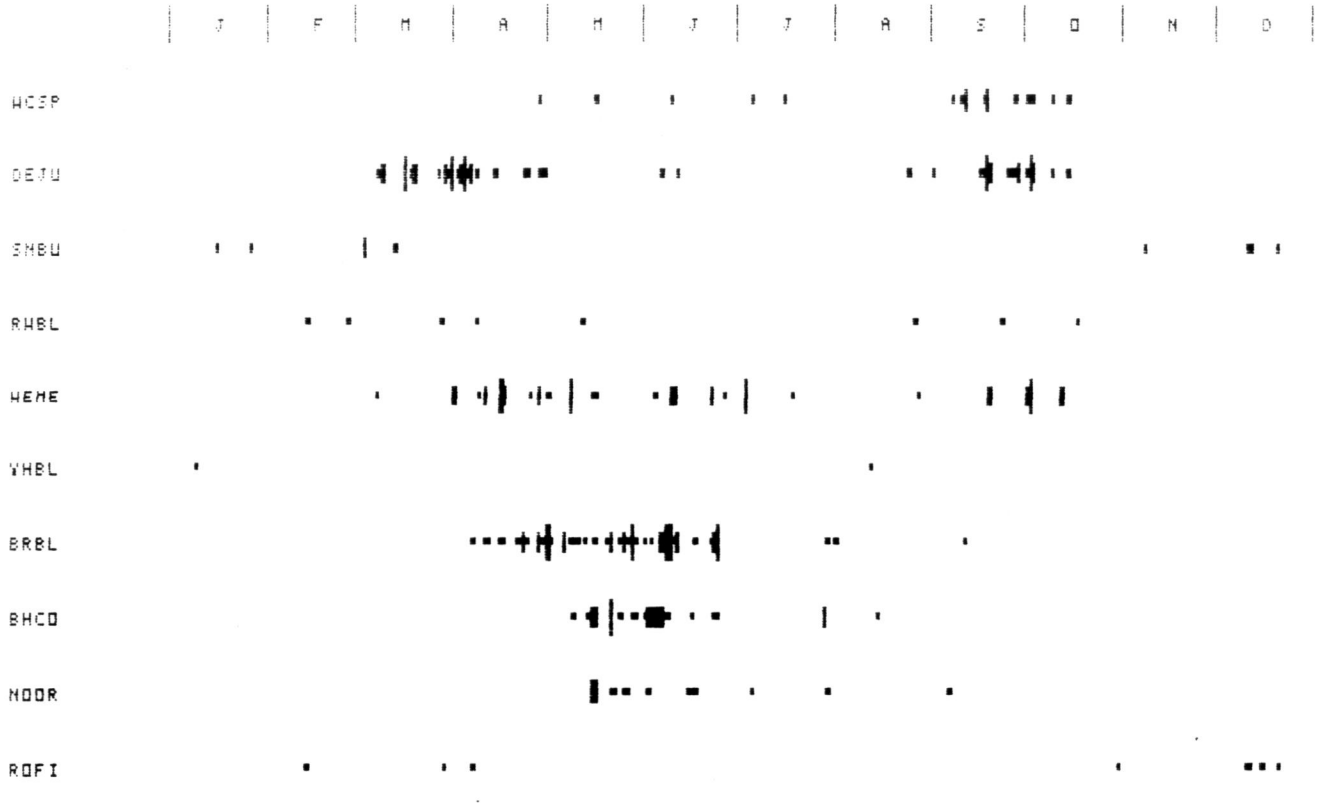


SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT

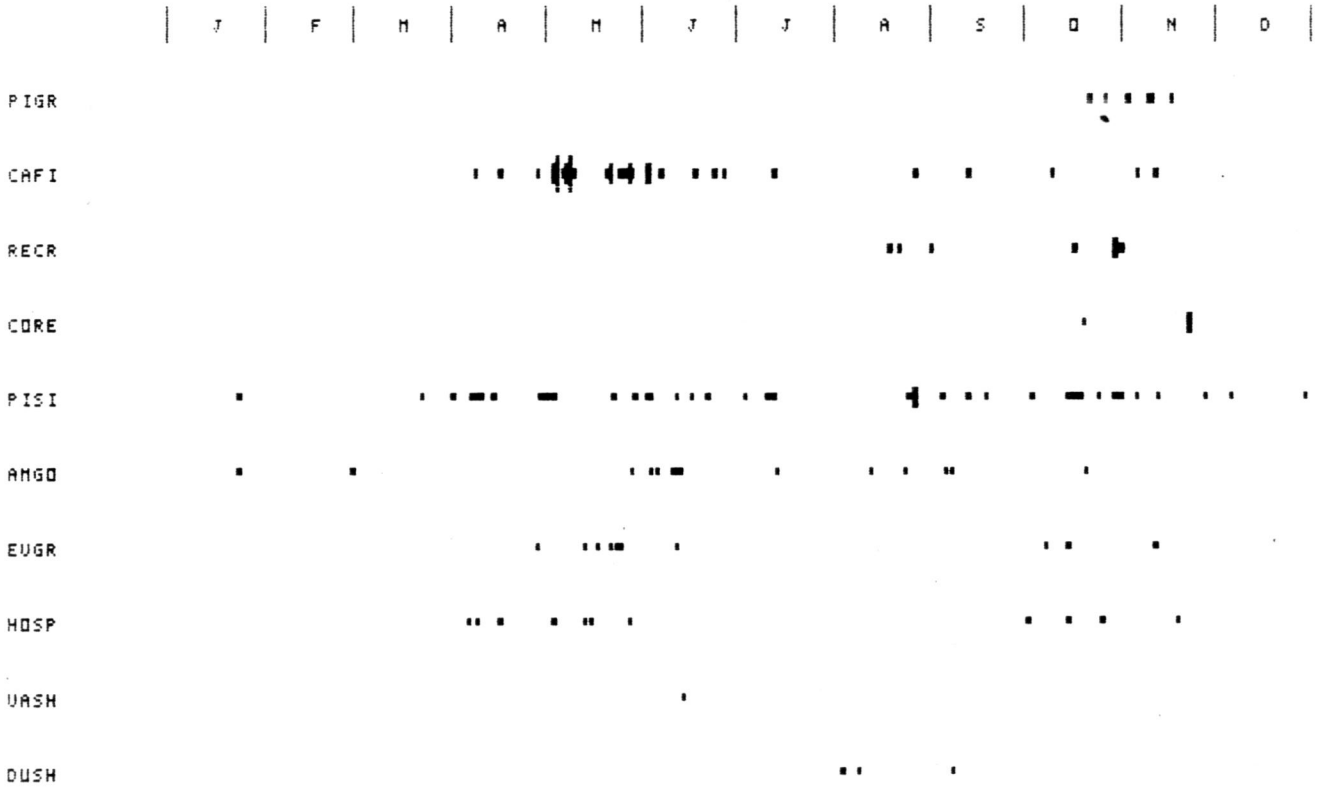
SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT



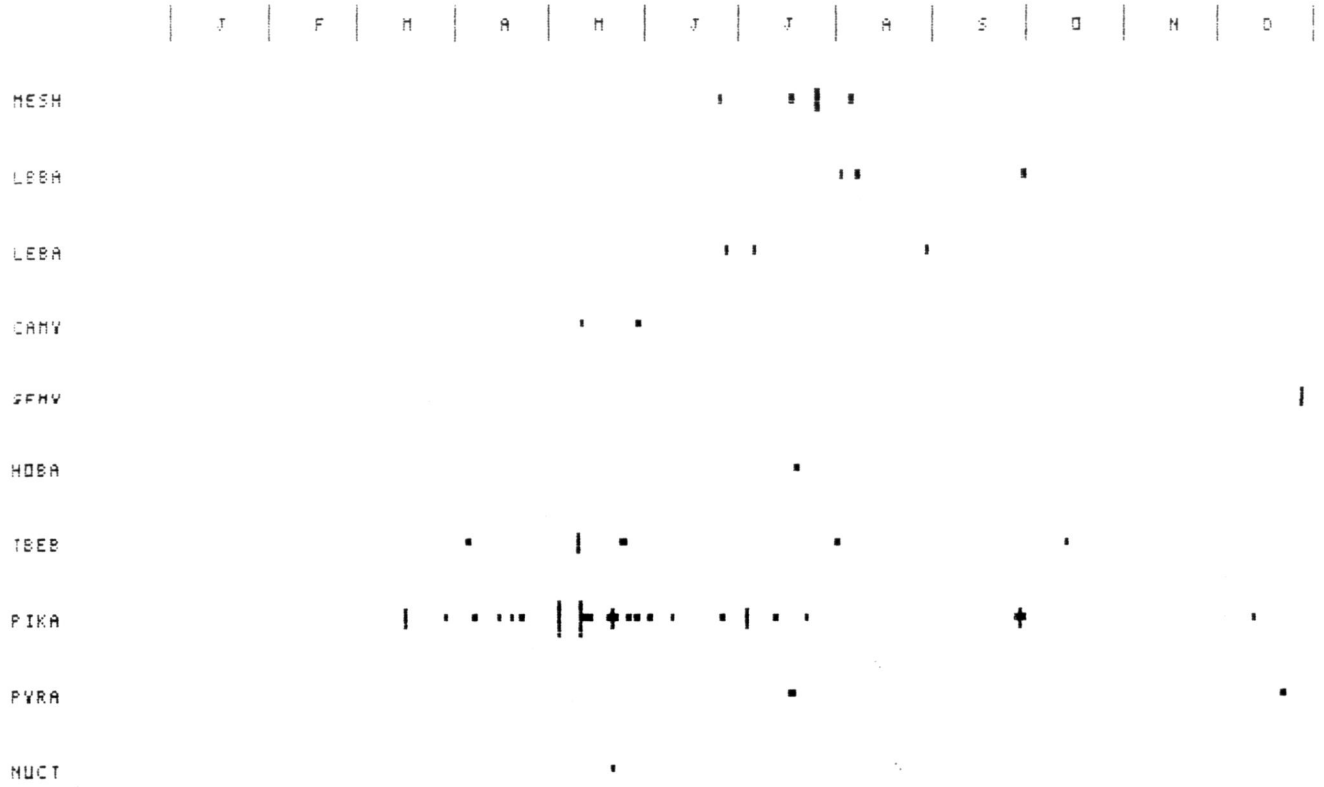
SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT



SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT

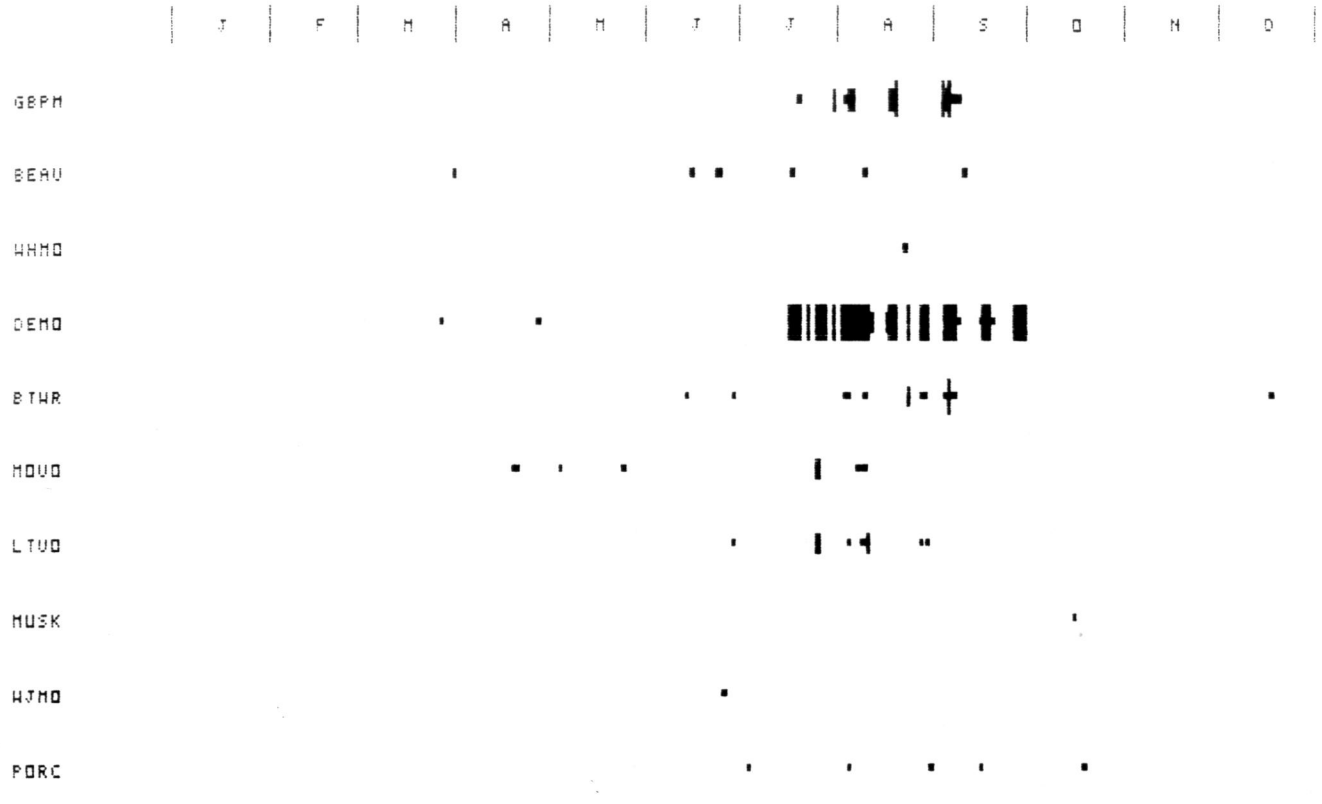


SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT

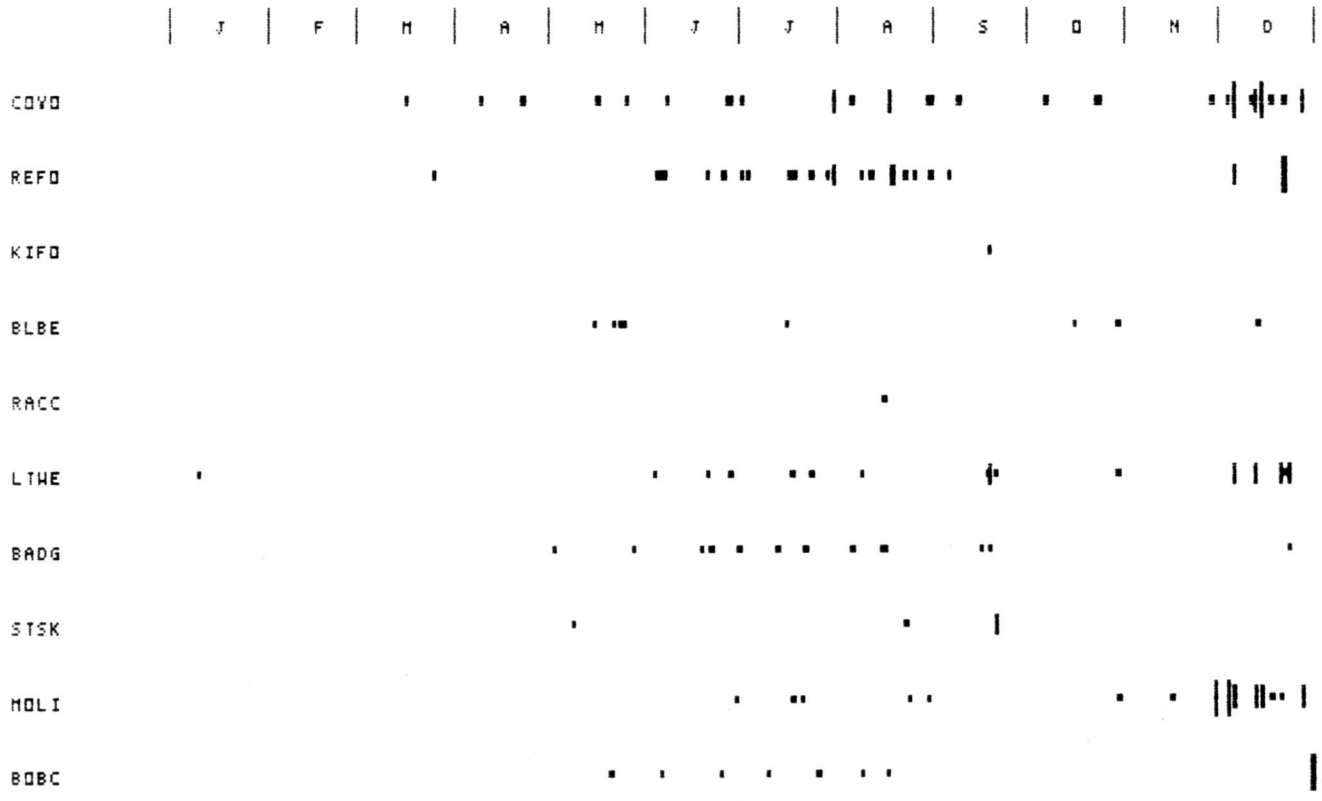


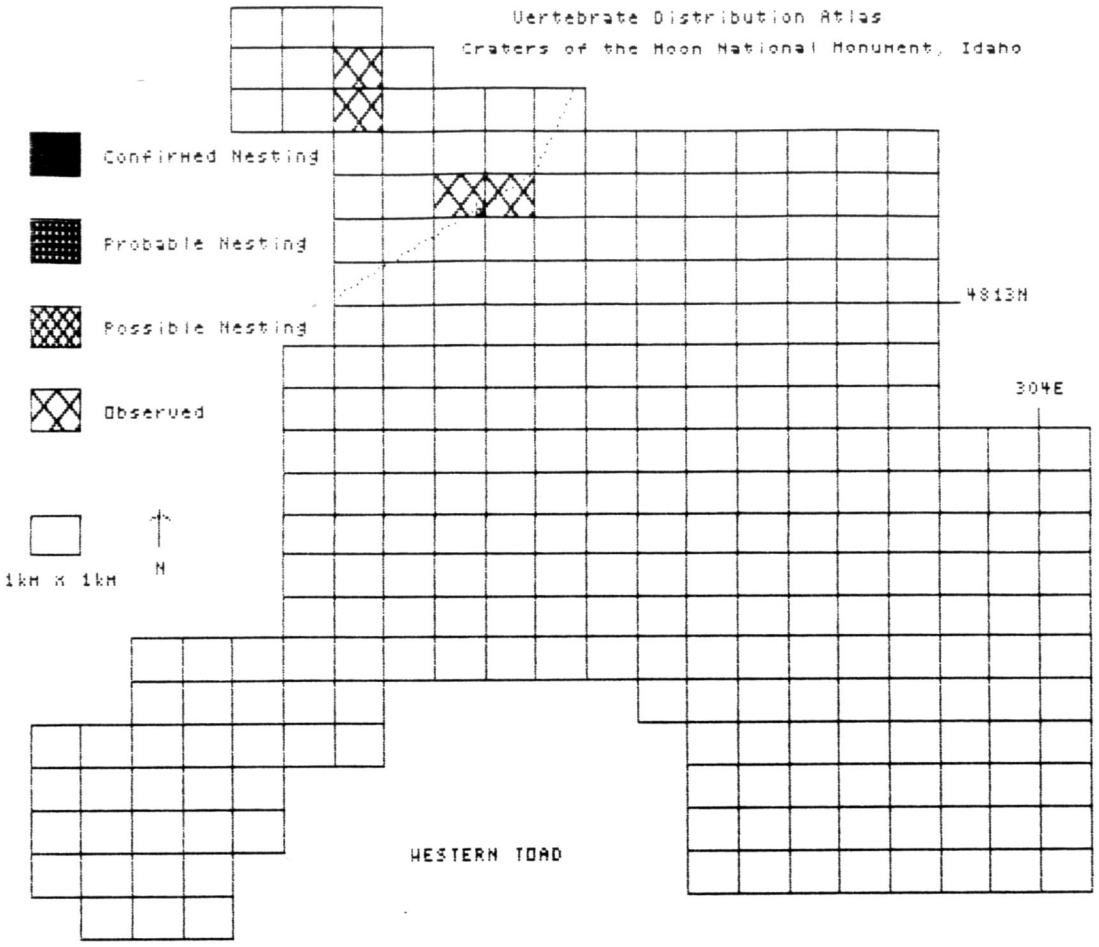
SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT

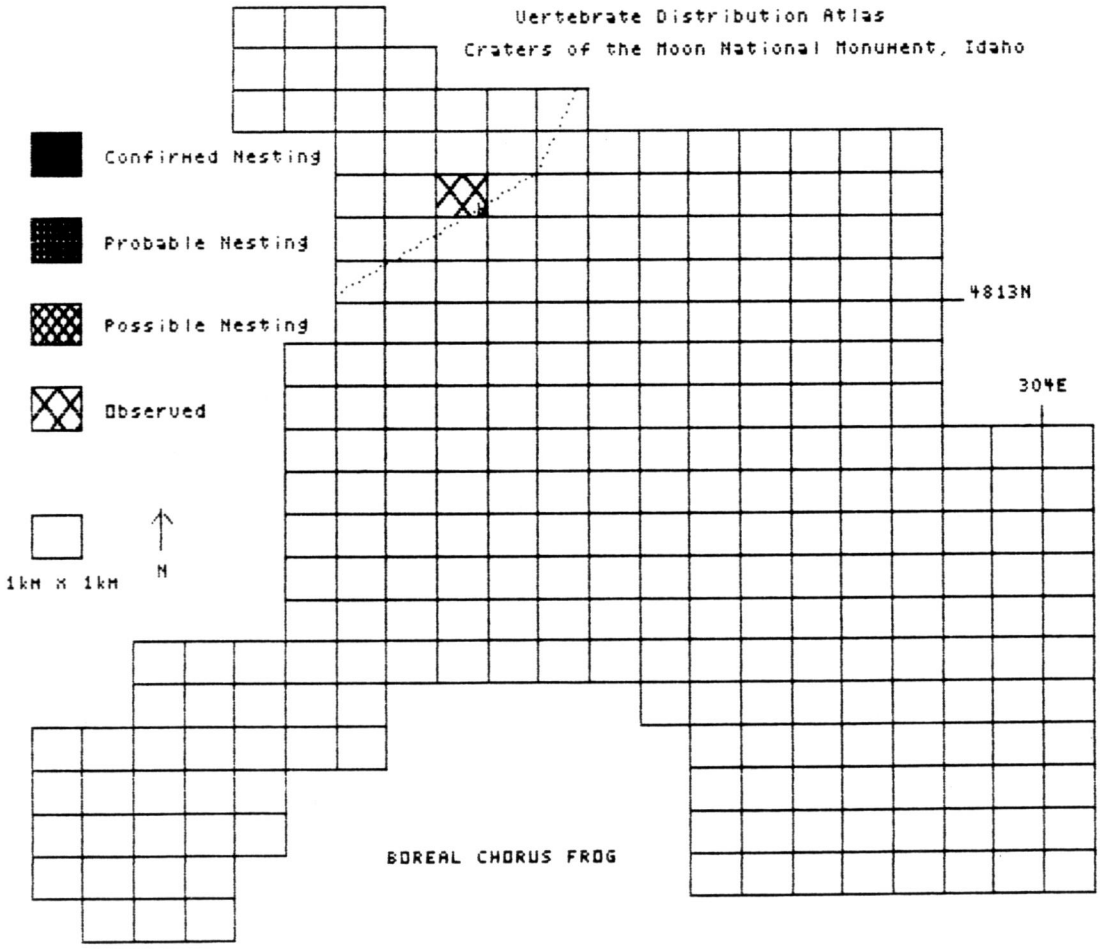
SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT

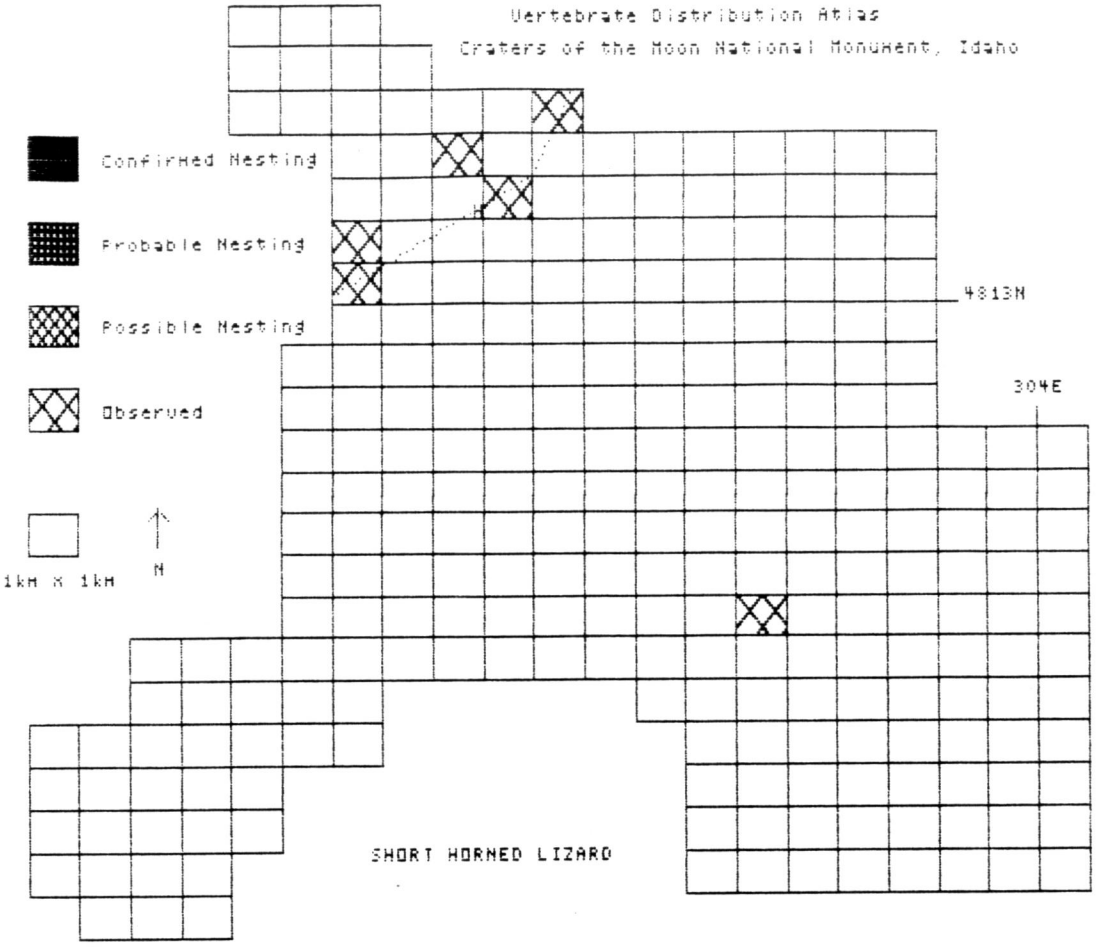


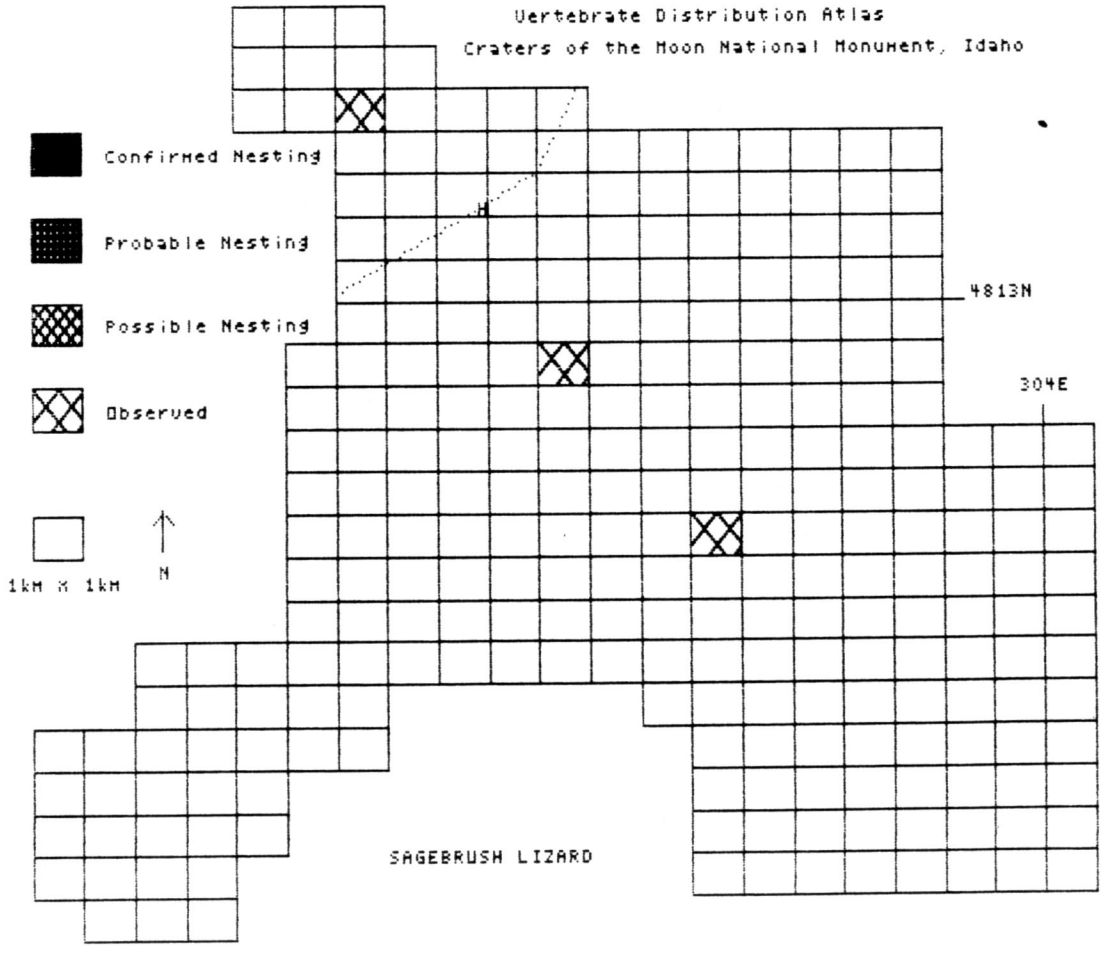
SEASONAL DISTRIBUTIONS FOR THE VERTEBRATES
OF CRATERS OF THE MOON NATIONAL MONUMENT

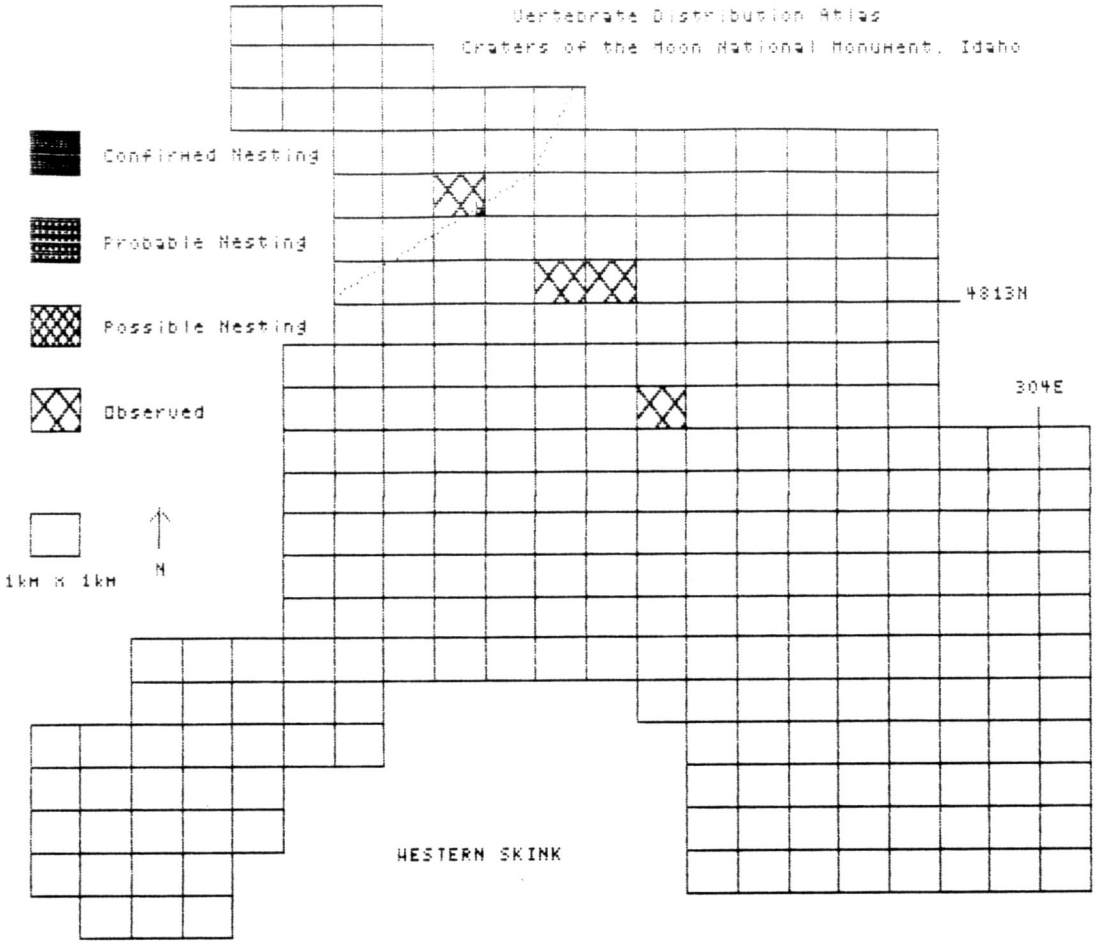


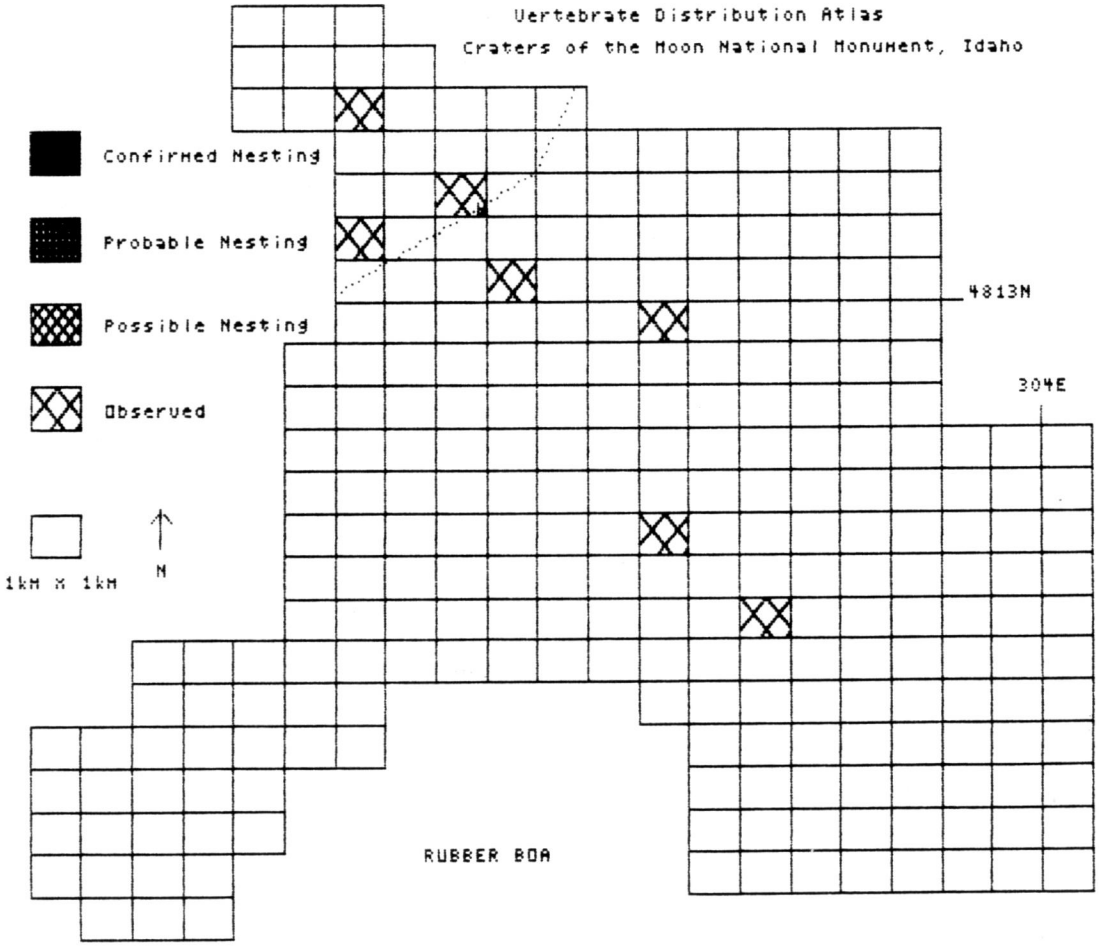

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WESTERN TOAD

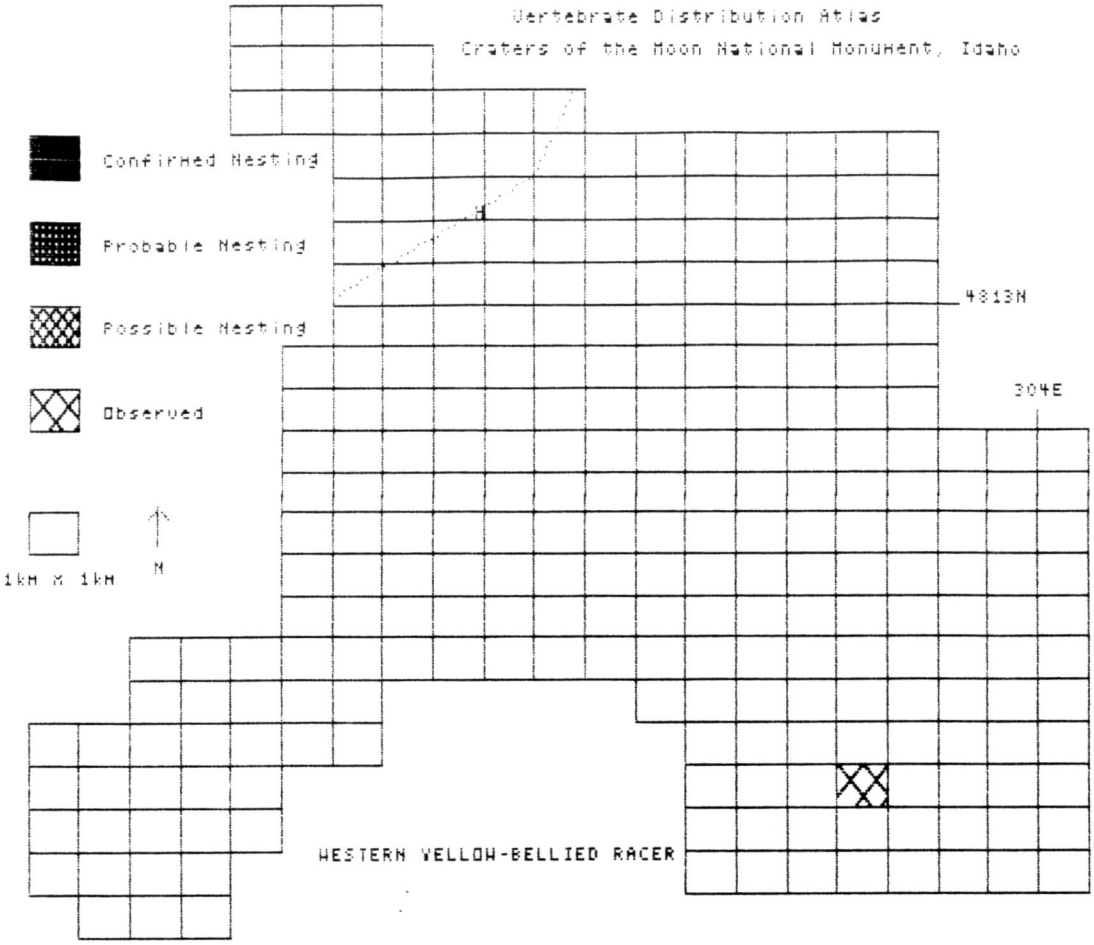

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
BOREAL CHORUS FROG

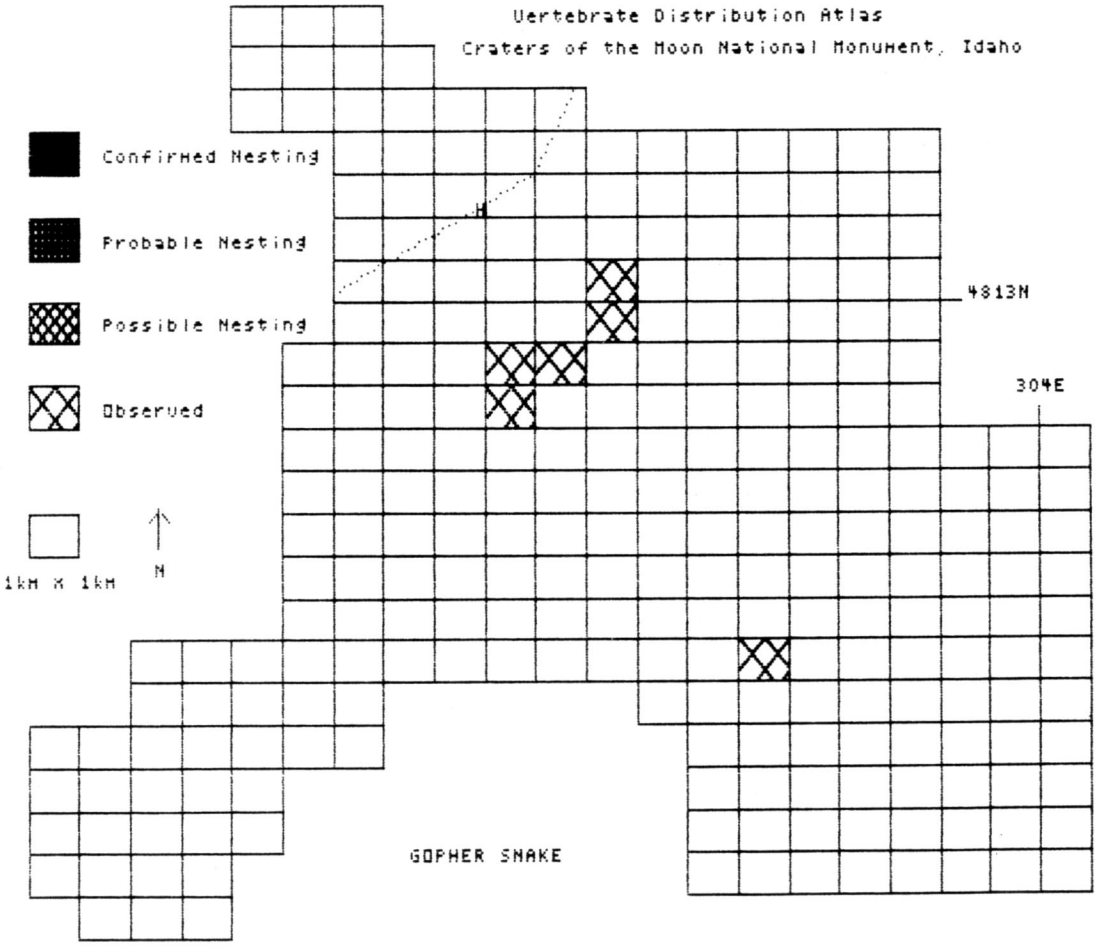

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
SHORT HORNED LIZARD

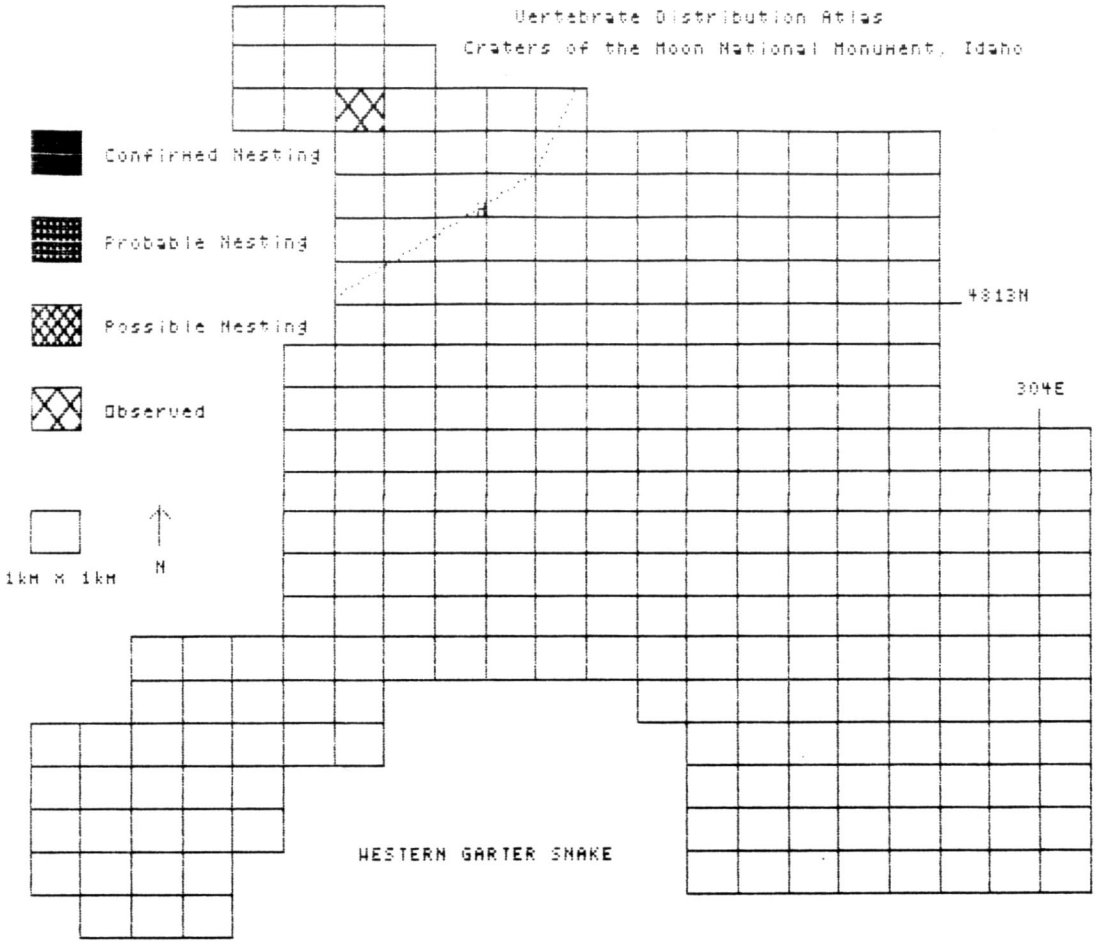

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
SAGEBRUSH LIZARD

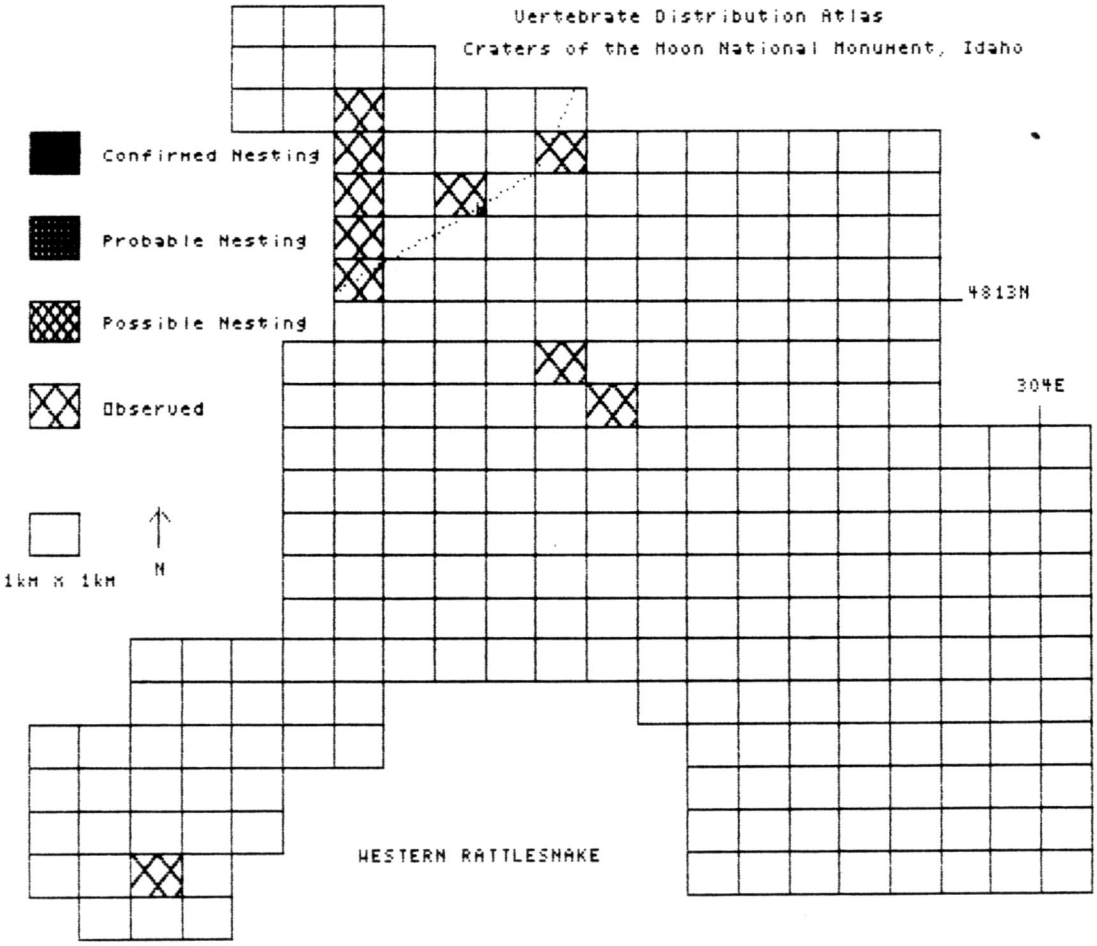

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WESTERN SKINK

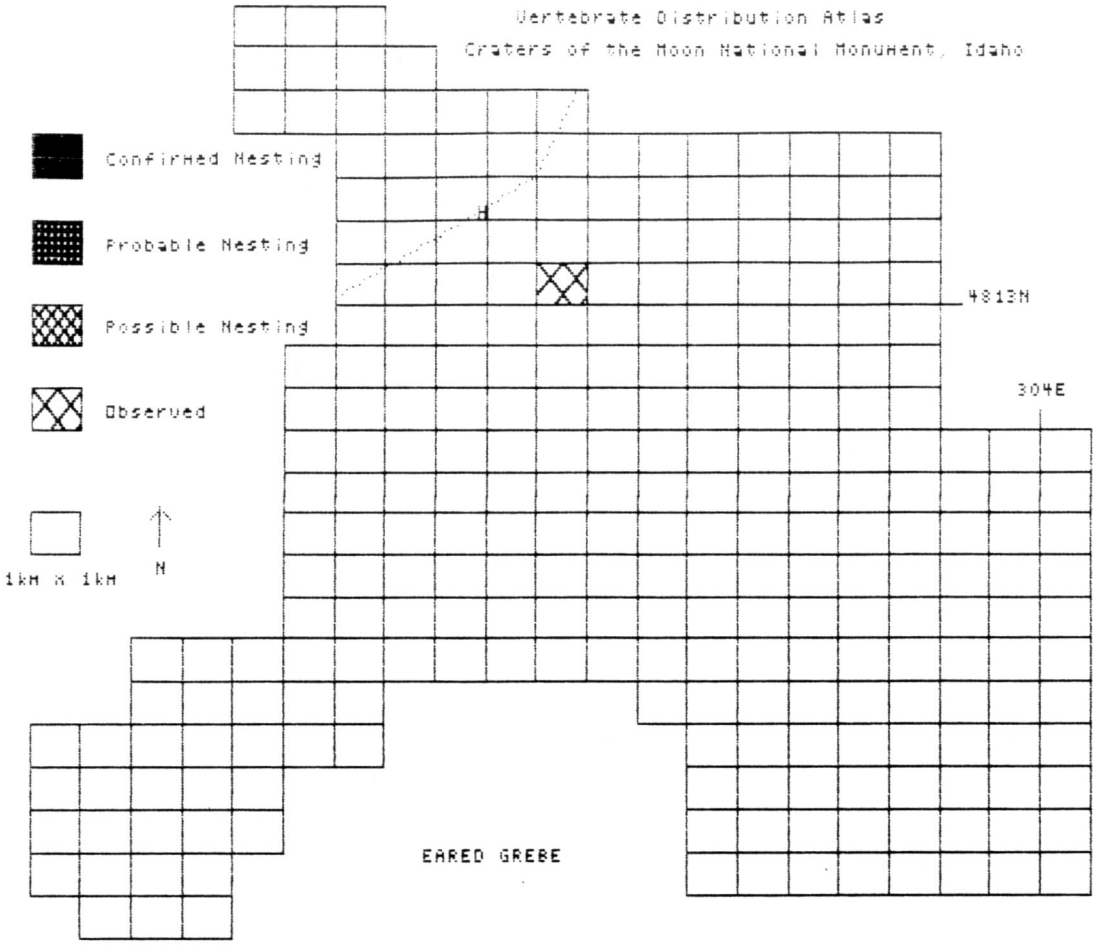

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
RUBBER BOA

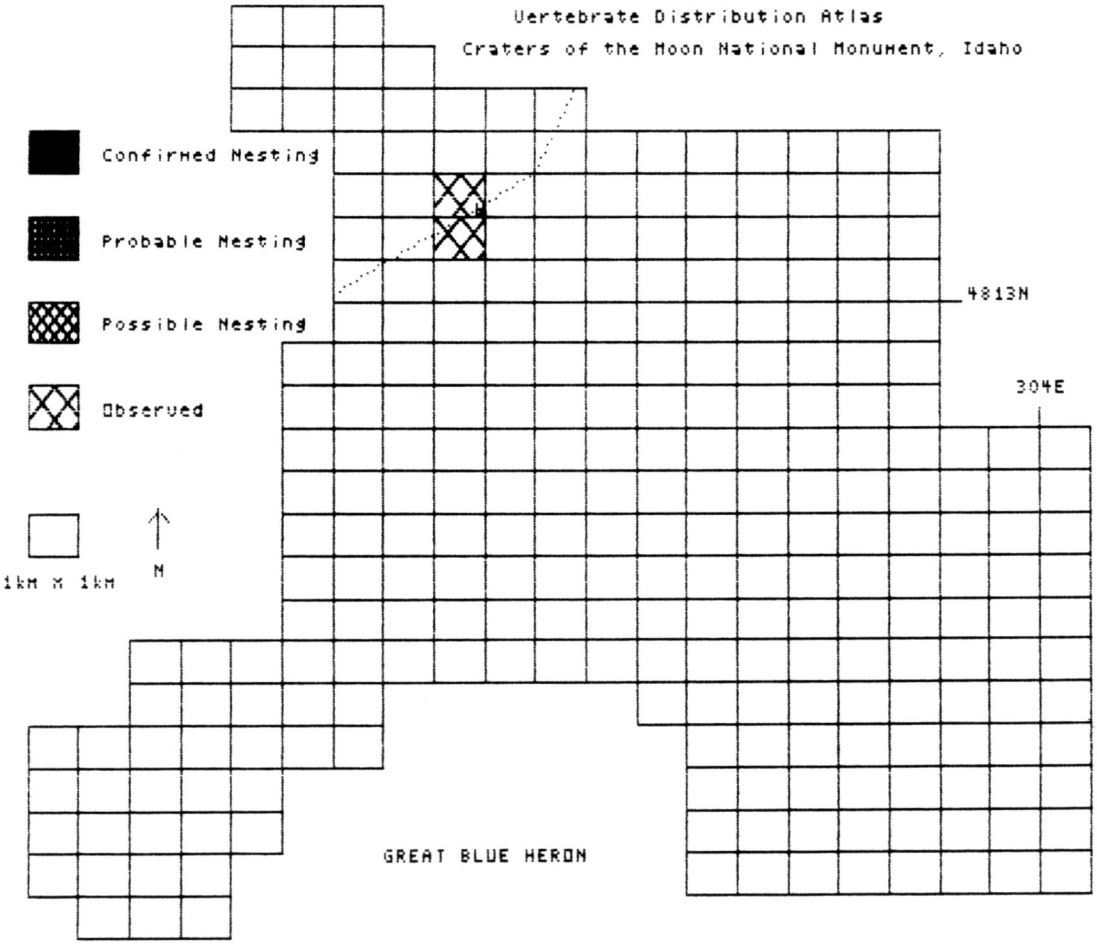

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
WESTERN YELLOW-BELLIED RACER

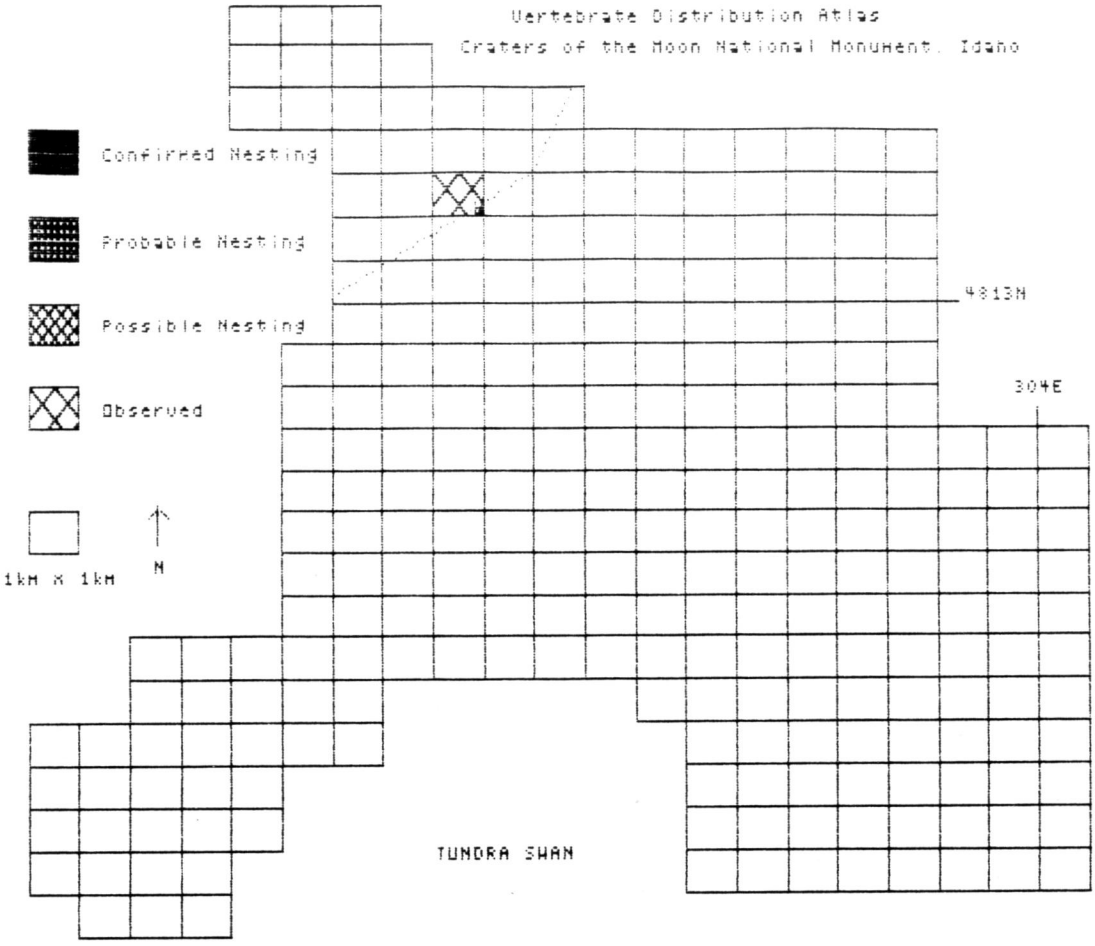

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
GOPHER SNAKE

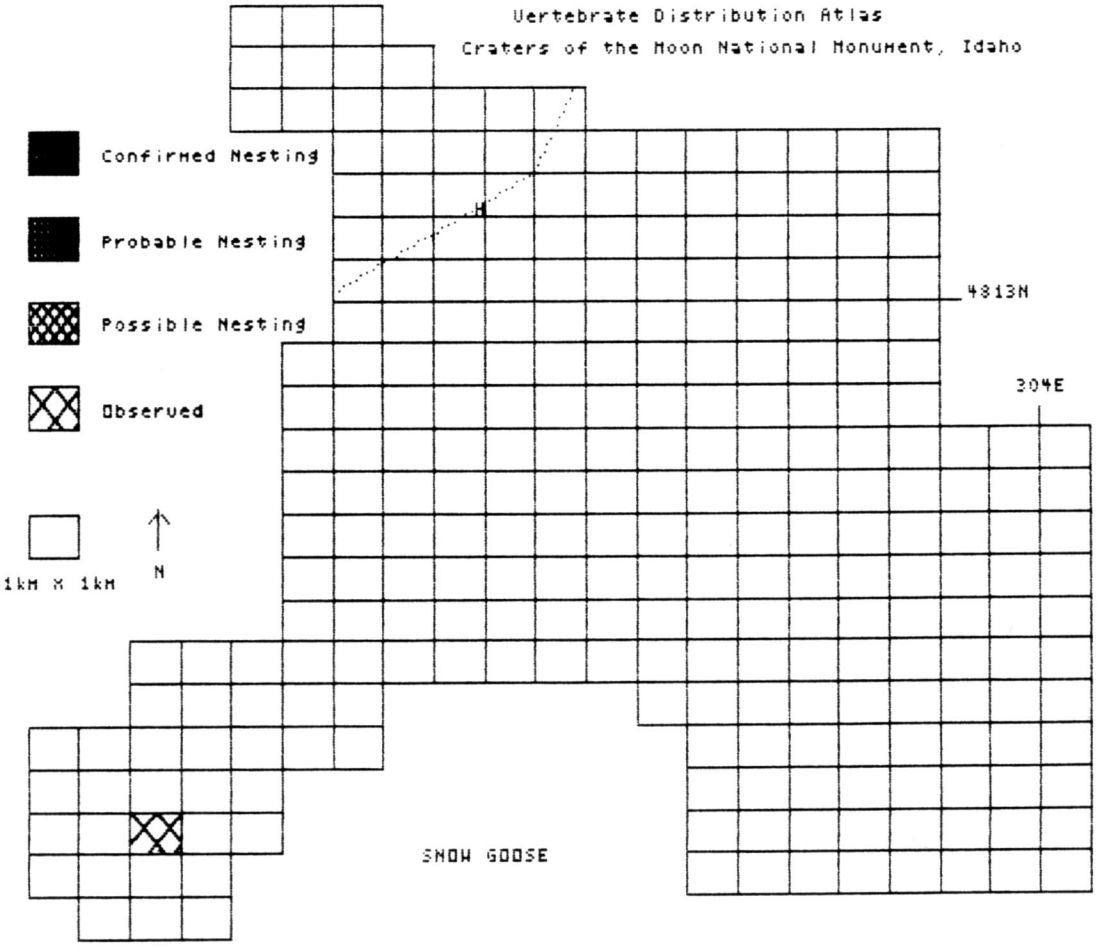

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WESTERN GARTER SNAKE

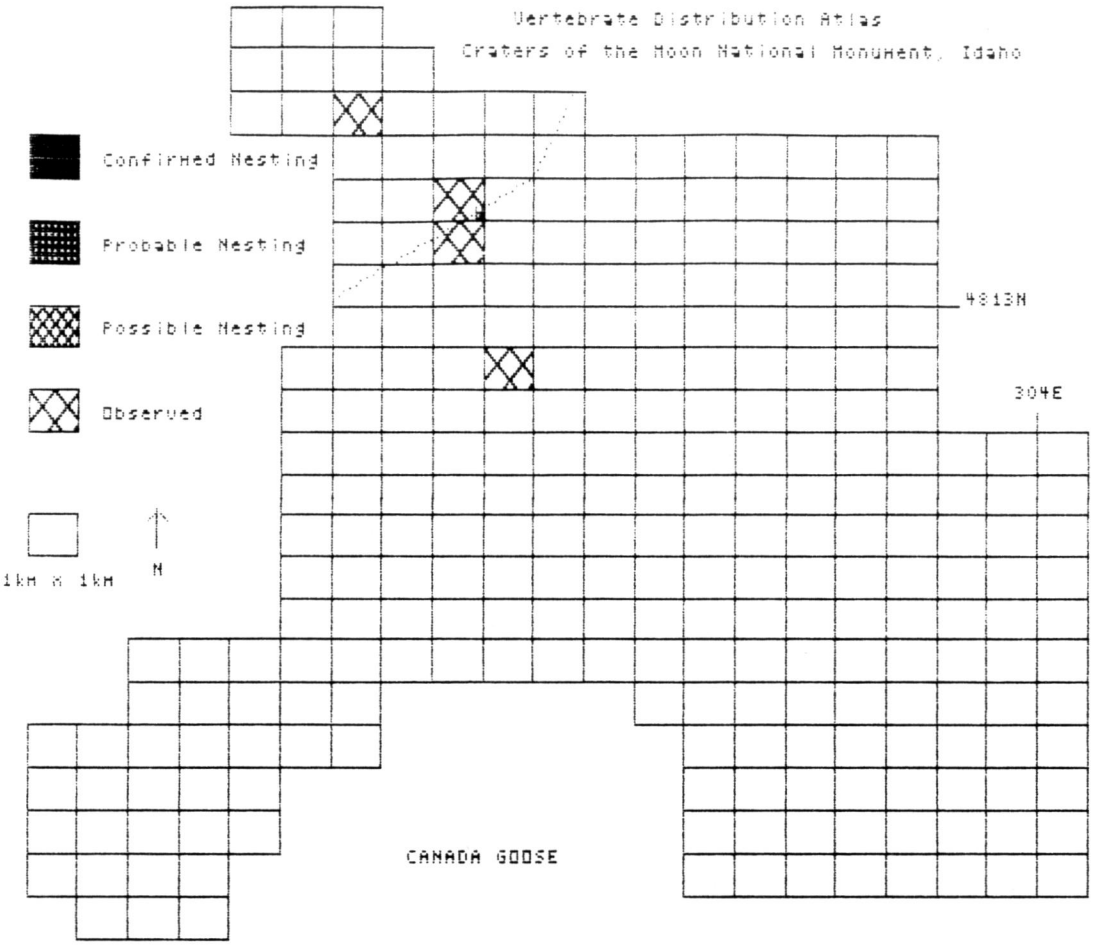

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WESTERN RATTLESNAKE

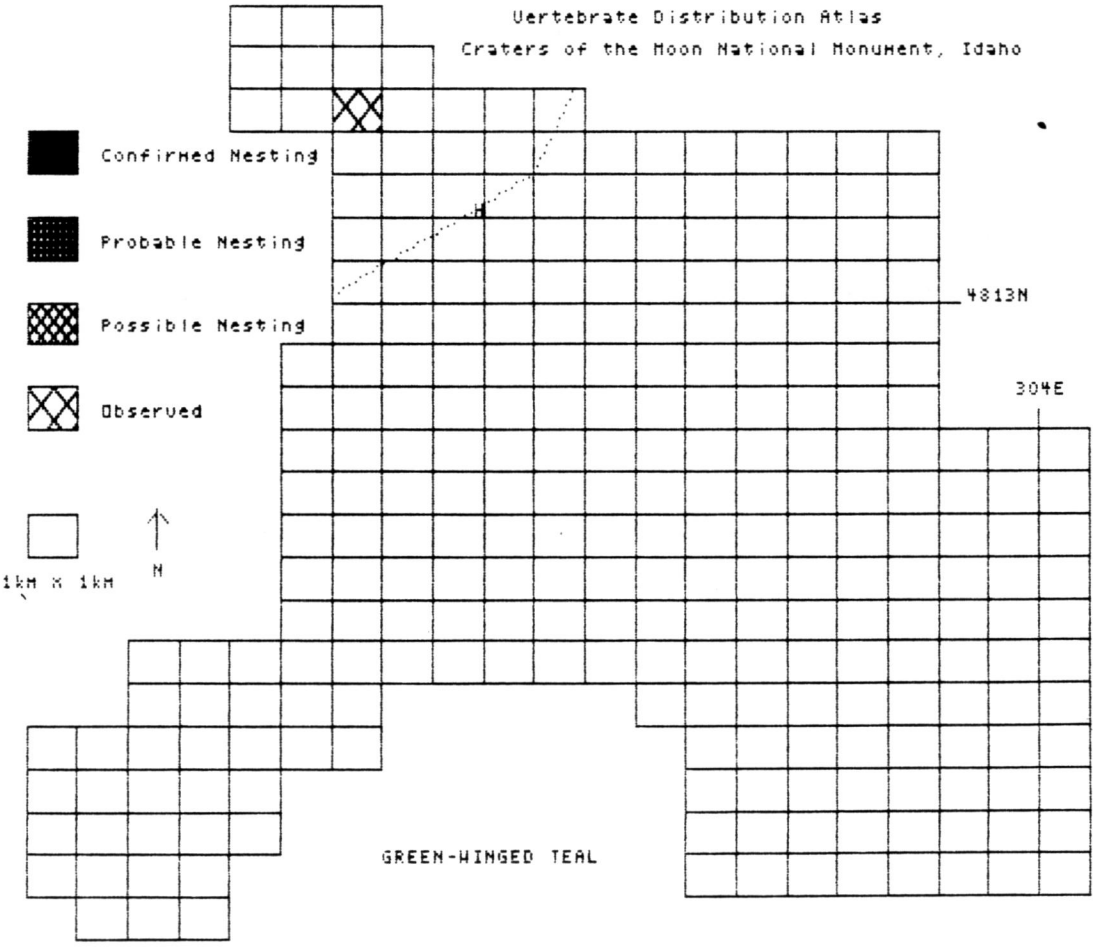

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
EARED GREBE

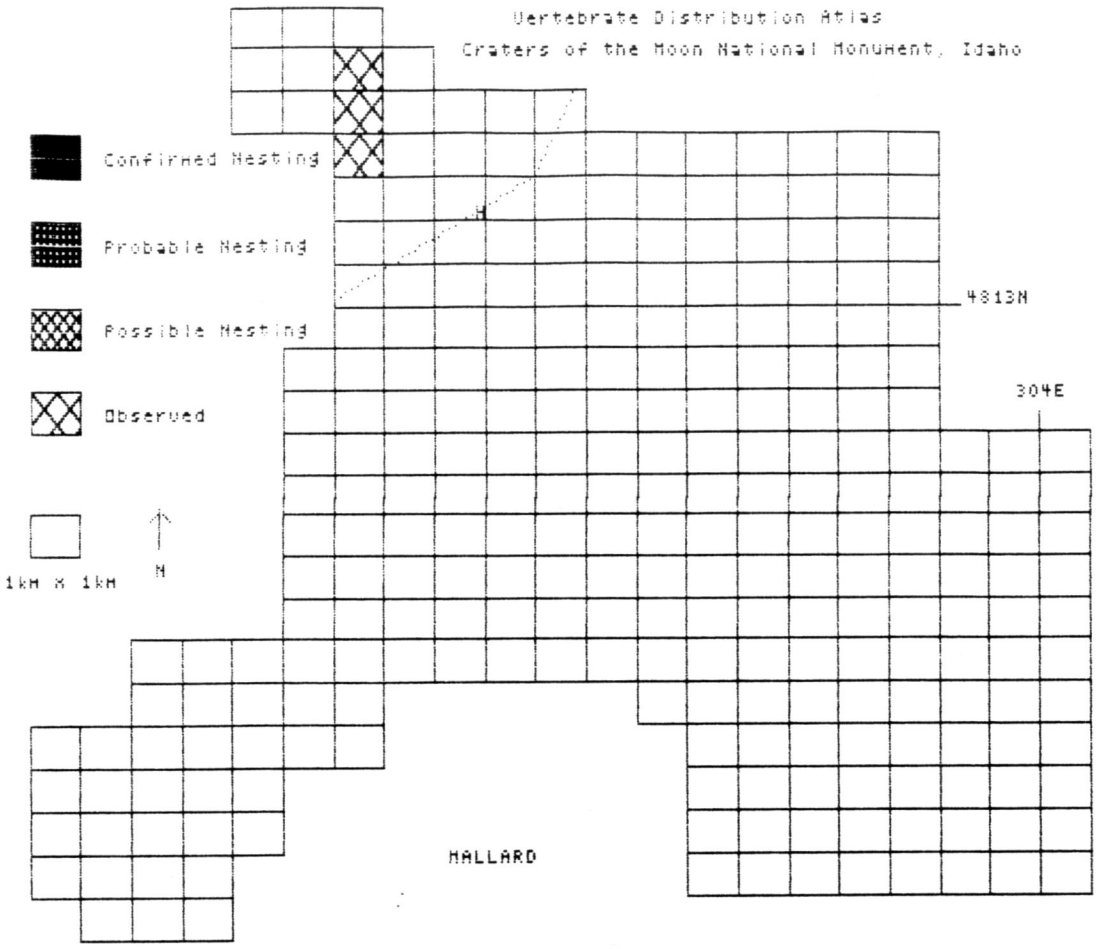

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
GREAT BLUE HERON

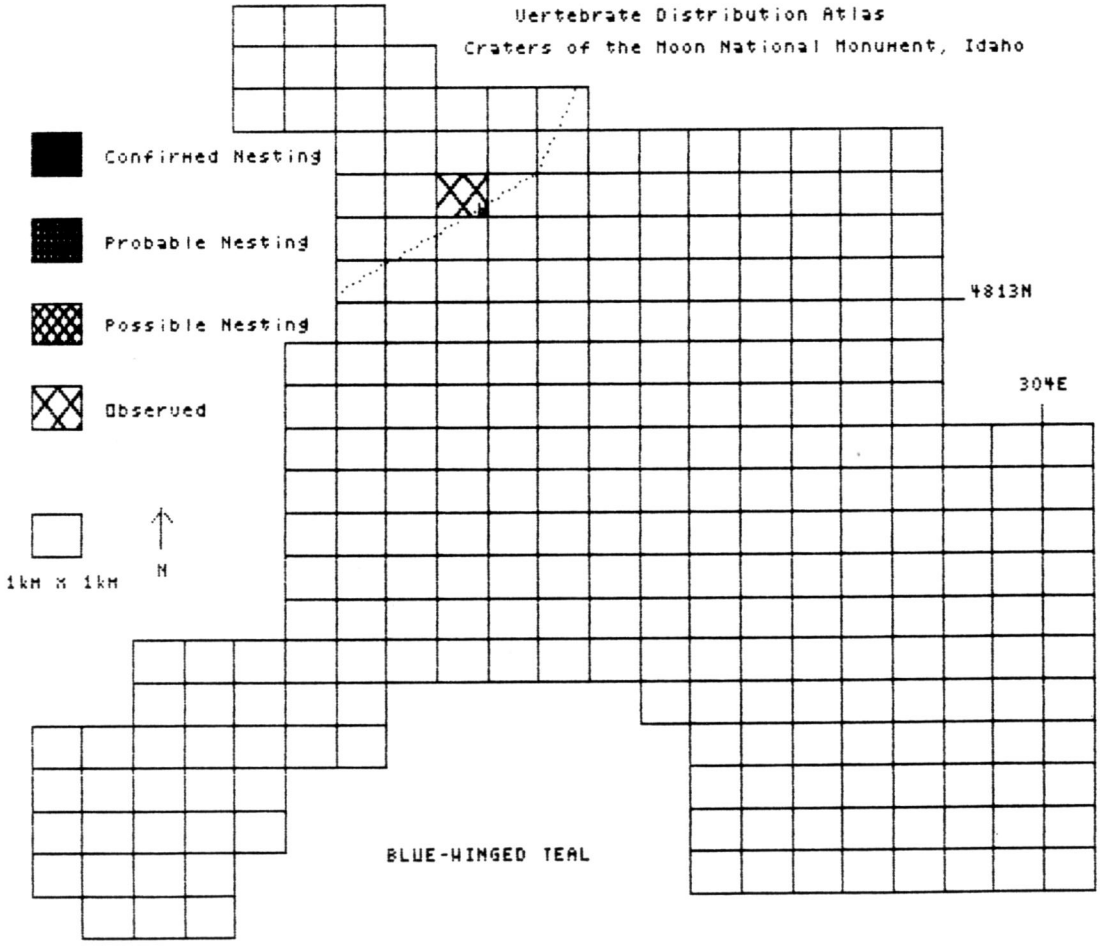

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
TUNDRA SWAN

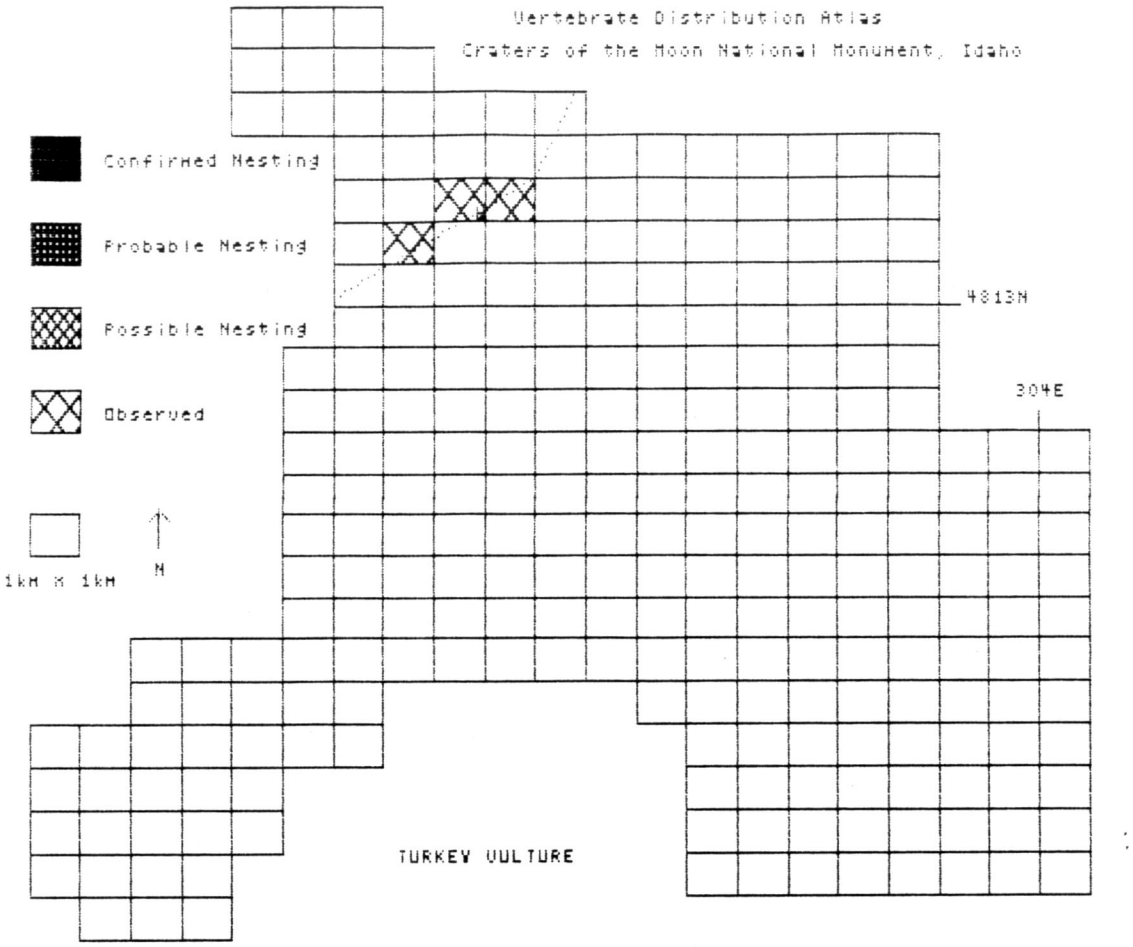

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
SNOW GOOSE

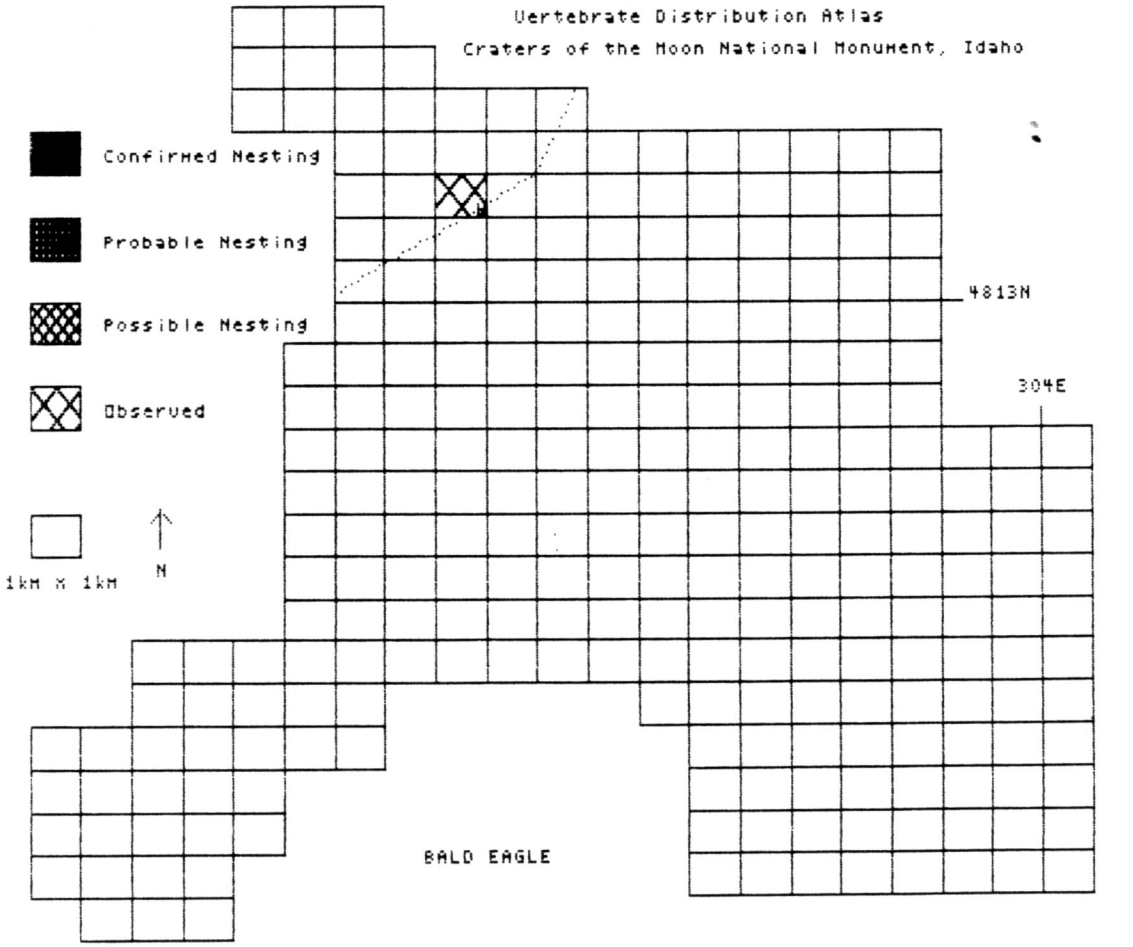

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
CANADA GOOSE

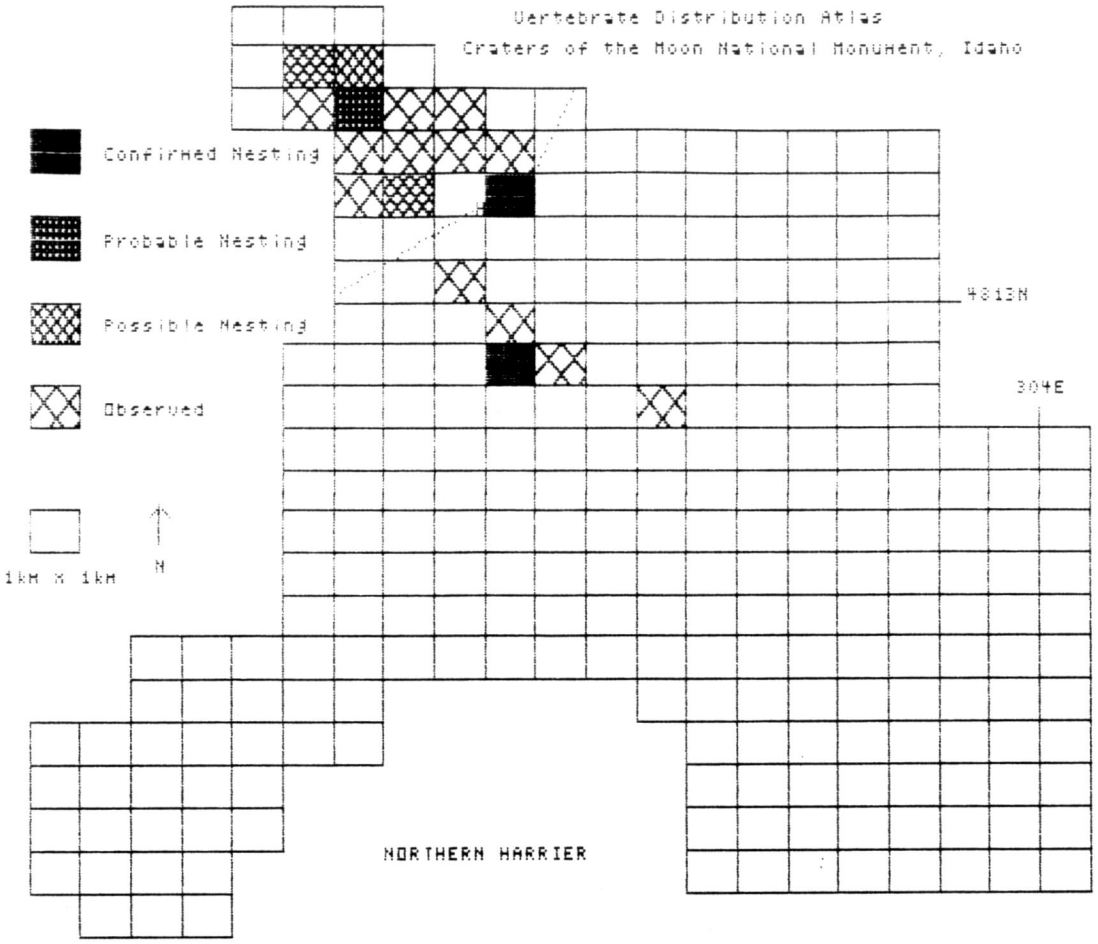

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
GREEN-WINGED TEAL

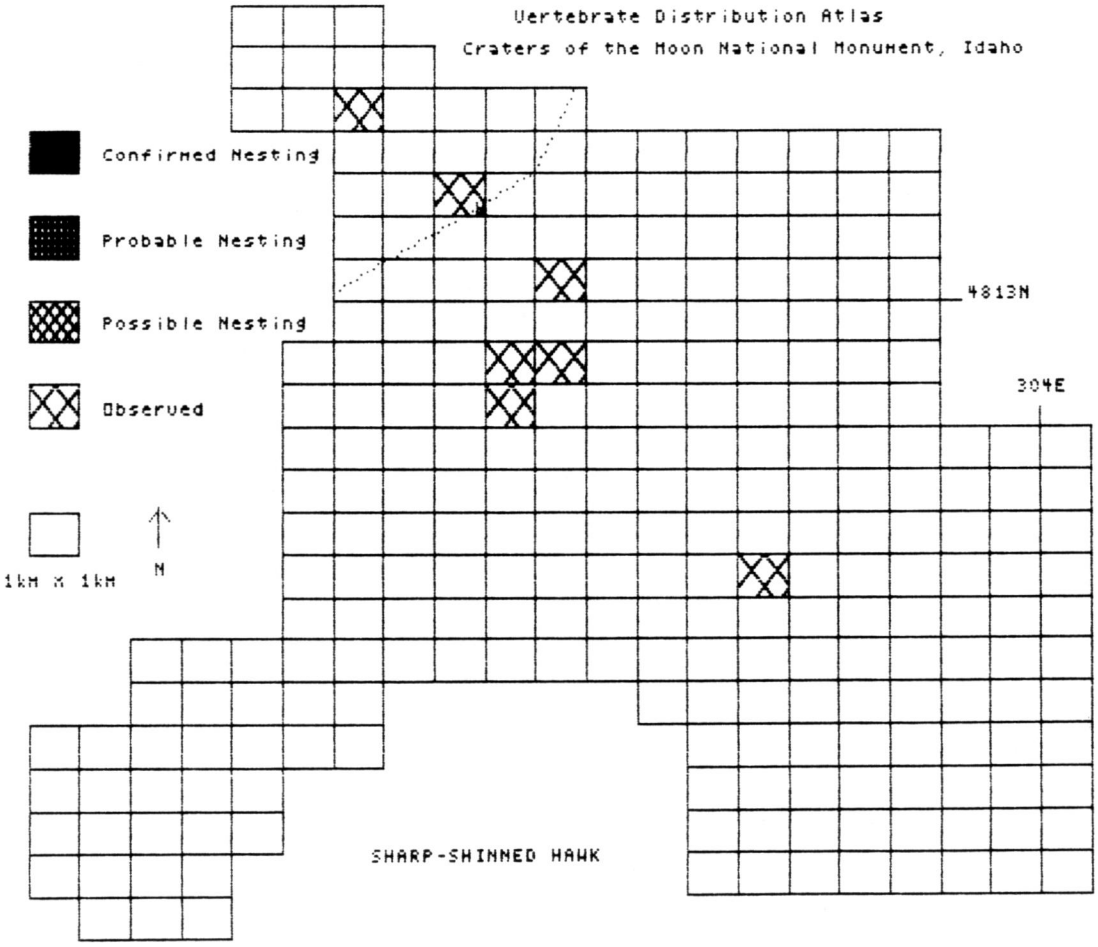

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
MALLARD

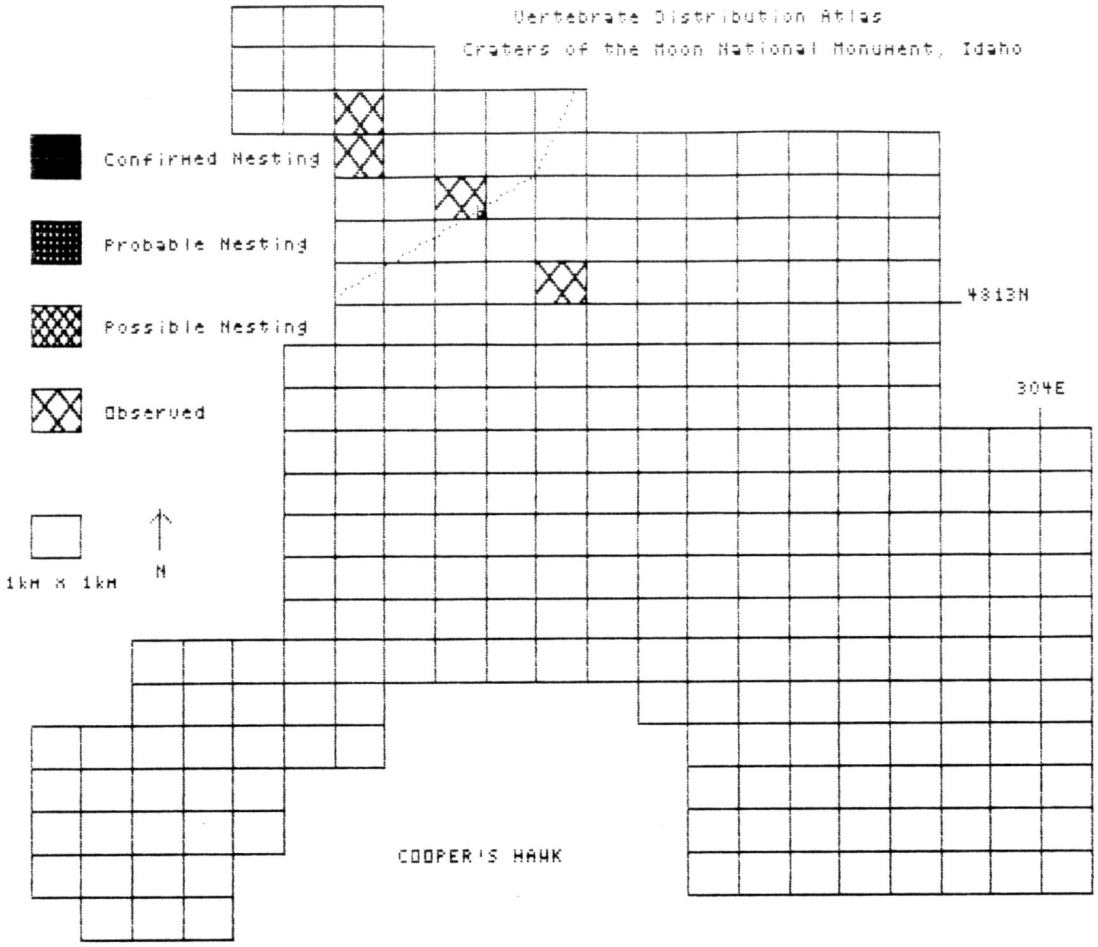

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
BLUE-WINGED TEAL

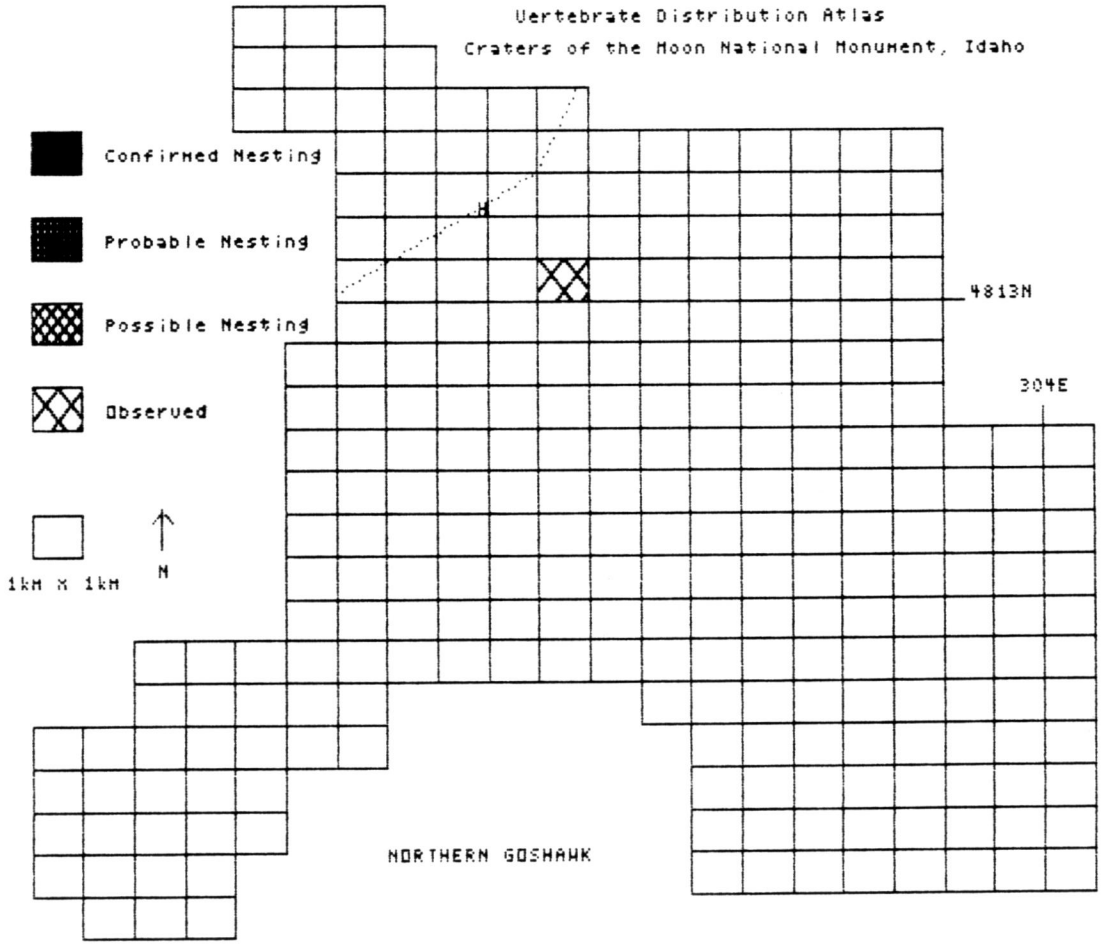

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
TURKEY VULTURE

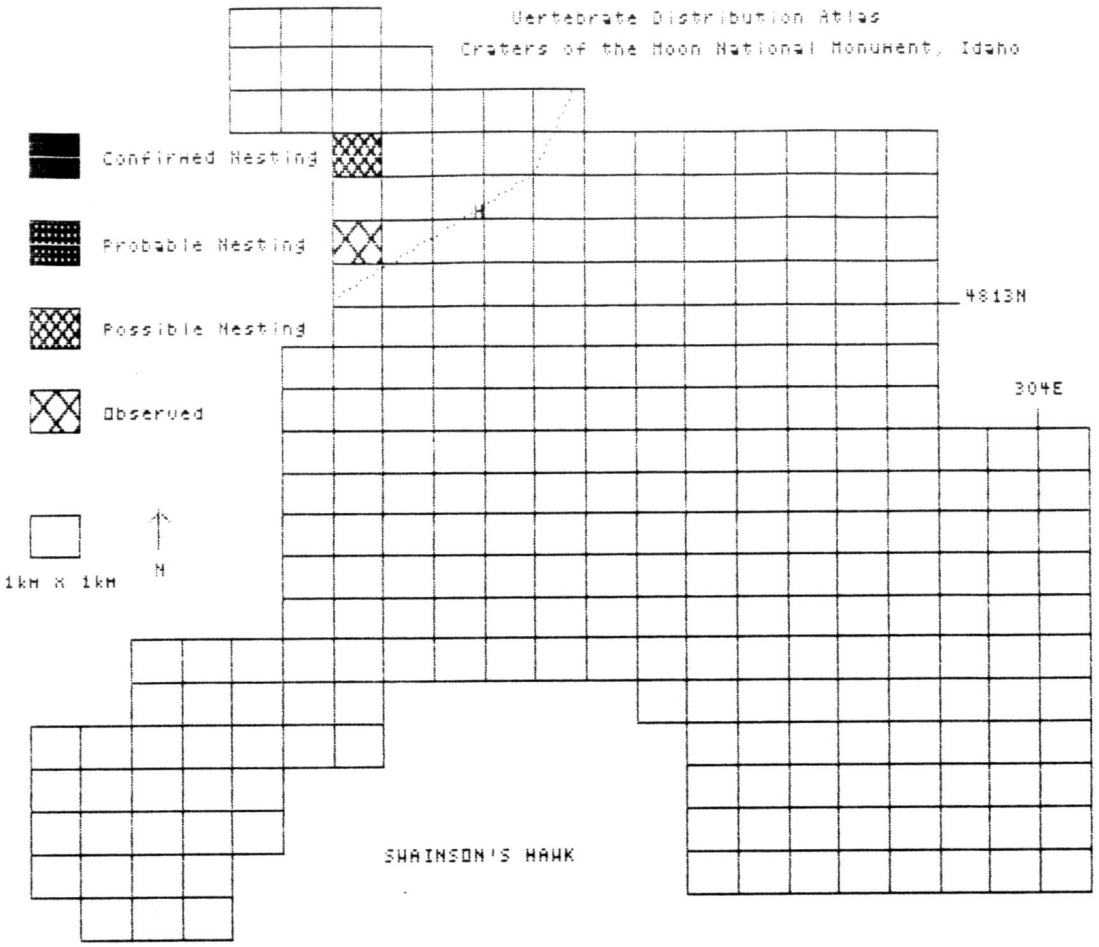

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
BALD EAGLE

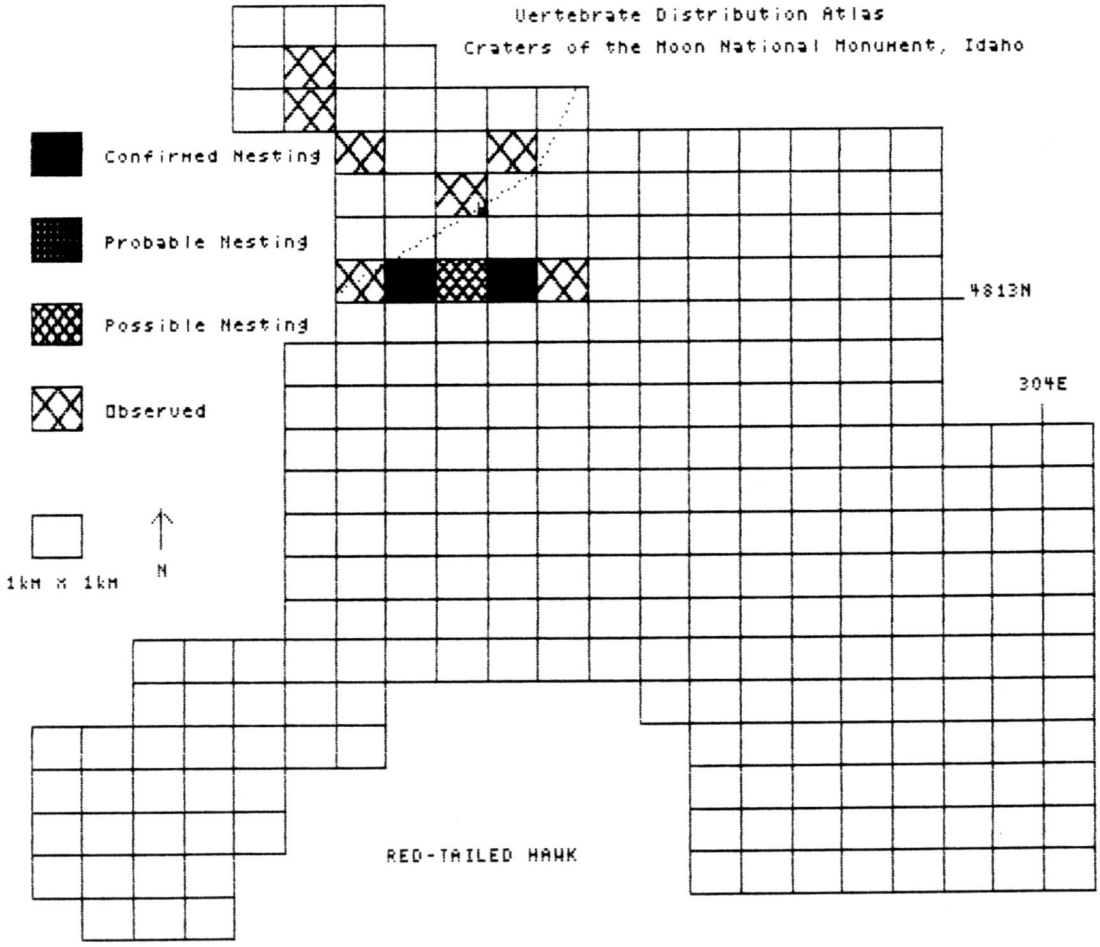

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
NORTHERN HARRIER

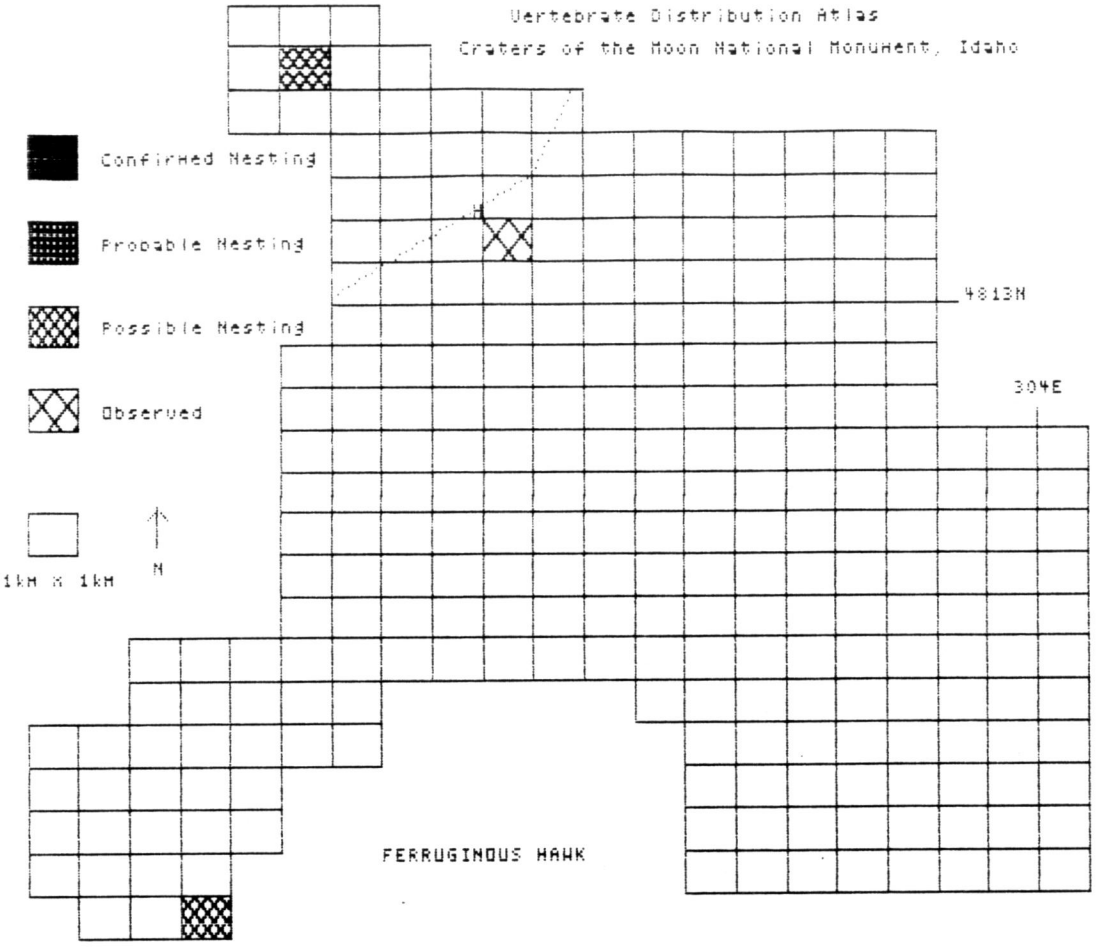

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
SHARP-SHINNED HAWK

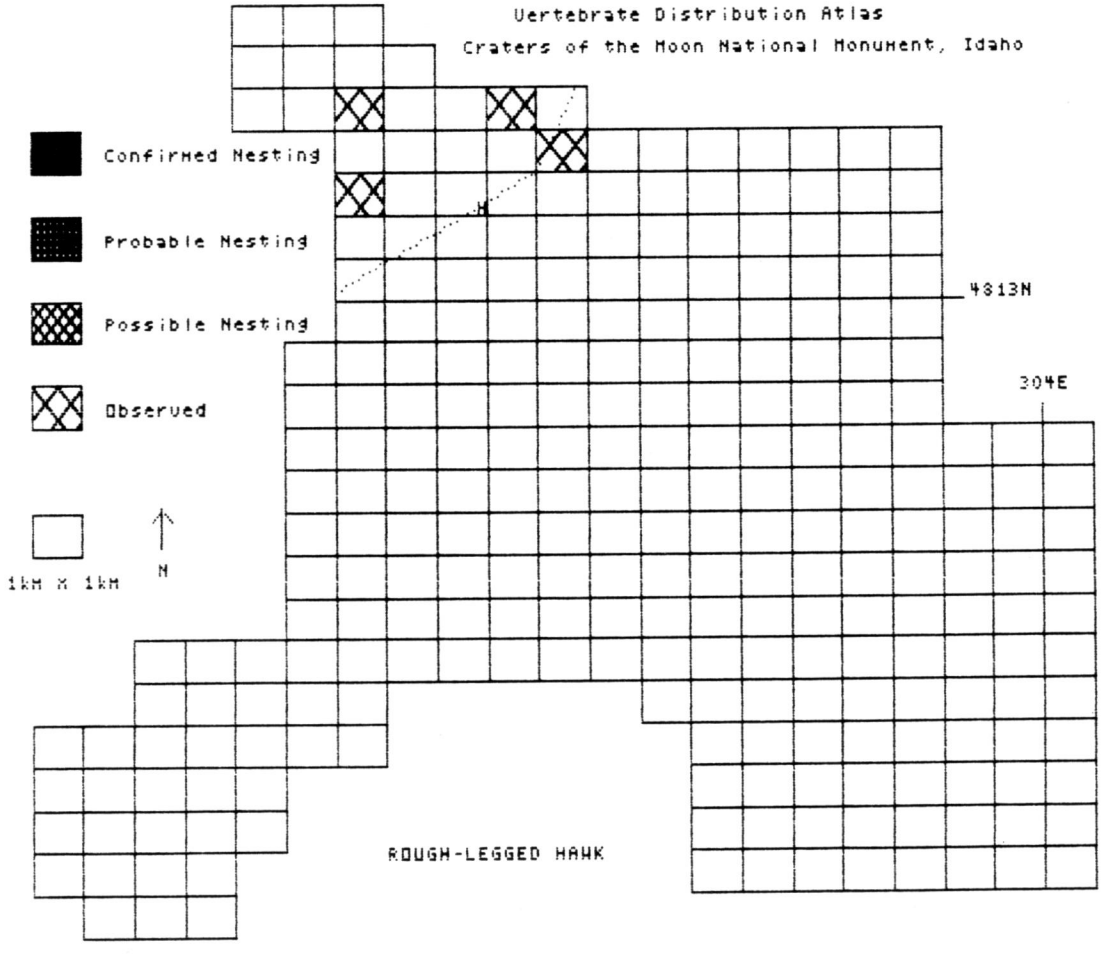

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
COOPER'S HAWK

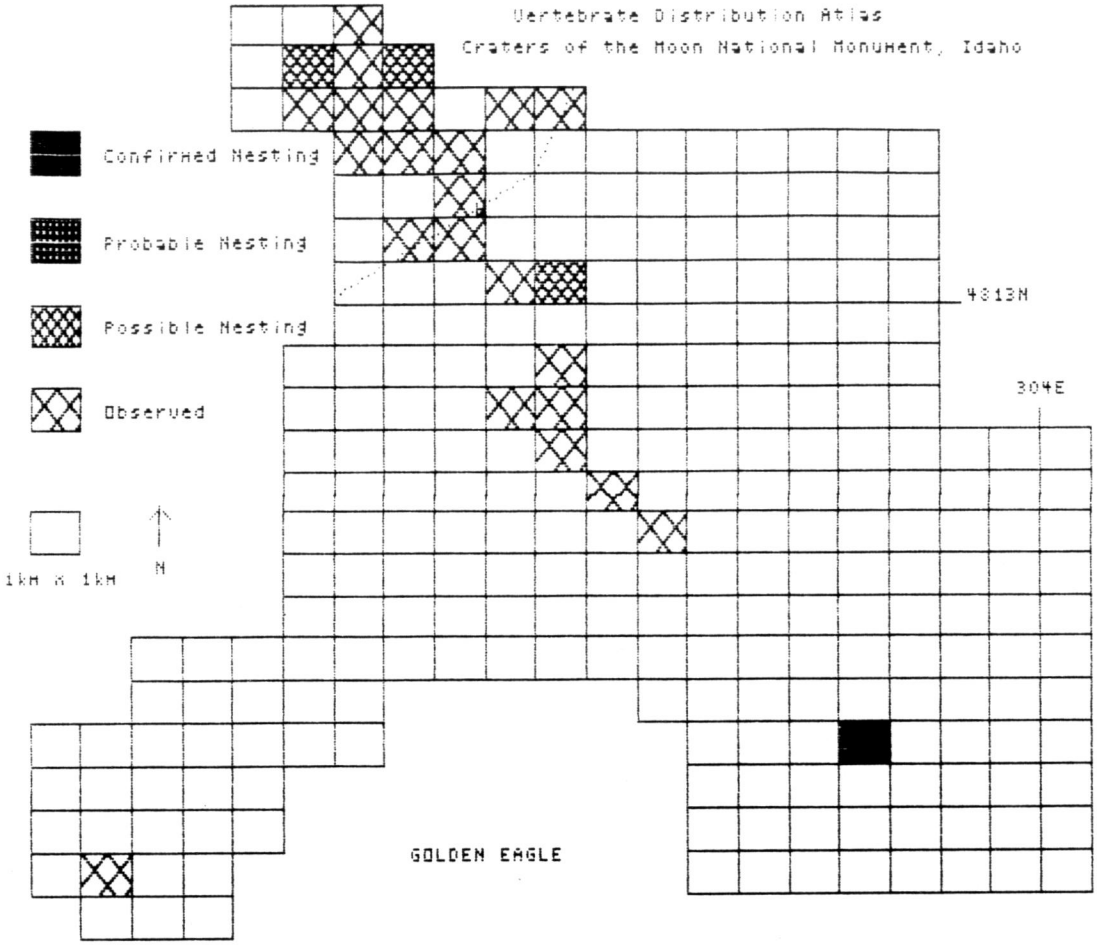

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
NORTHERN GOSHAWK

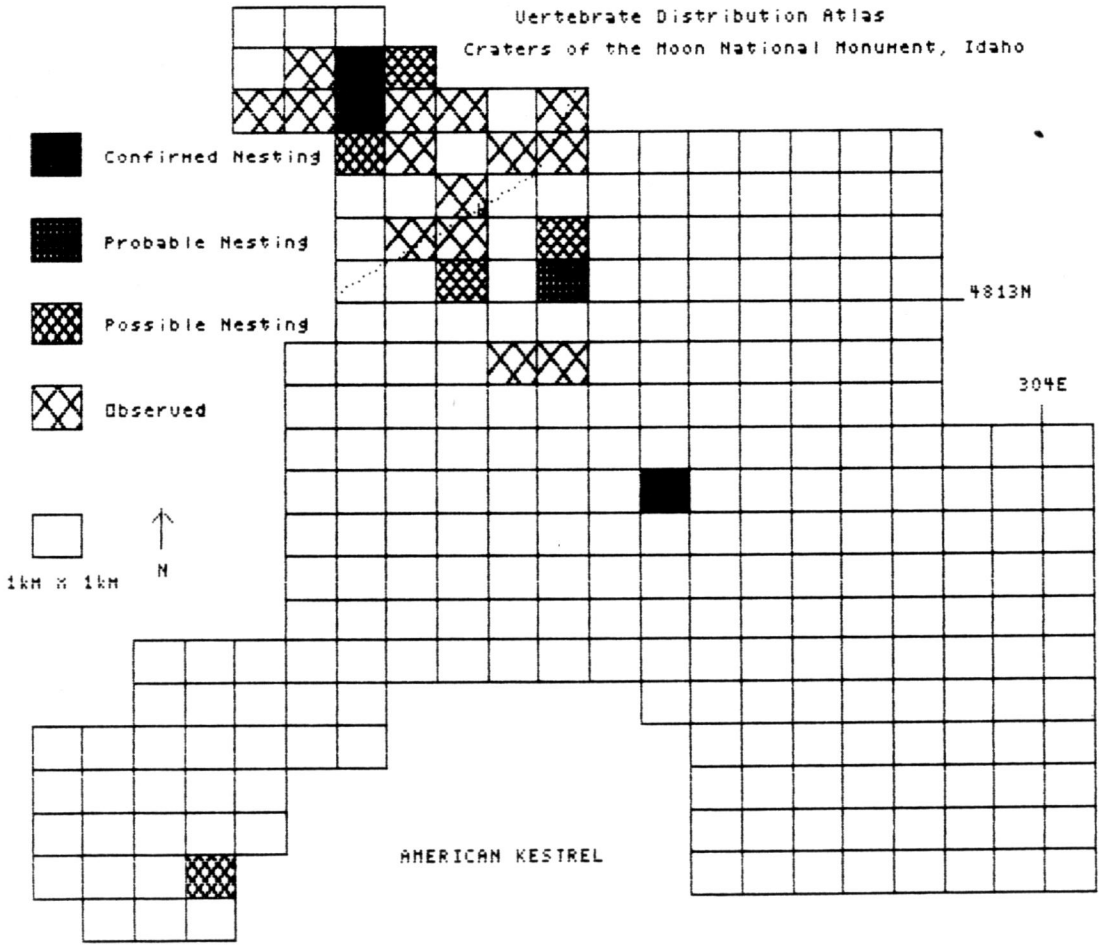

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
SWAINSON'S HAWK

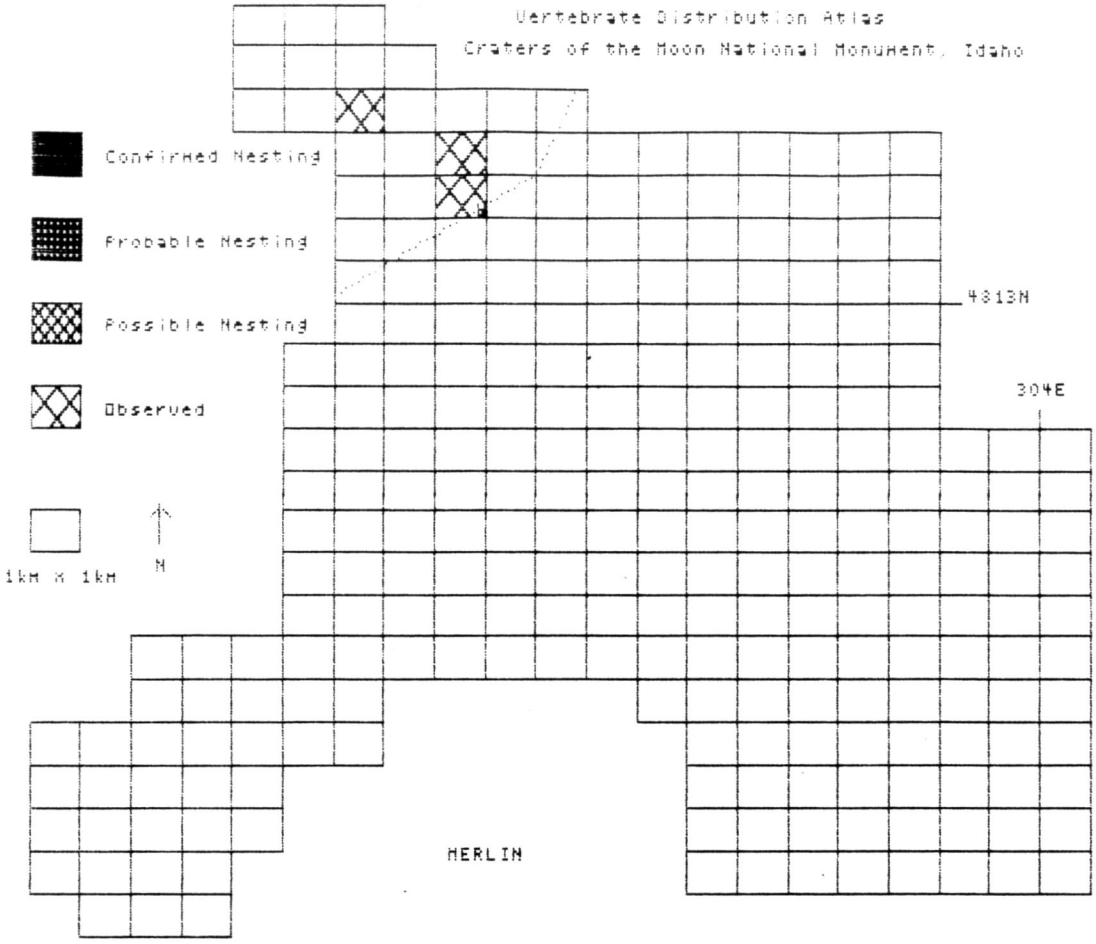

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
RED-TAILED HAWK

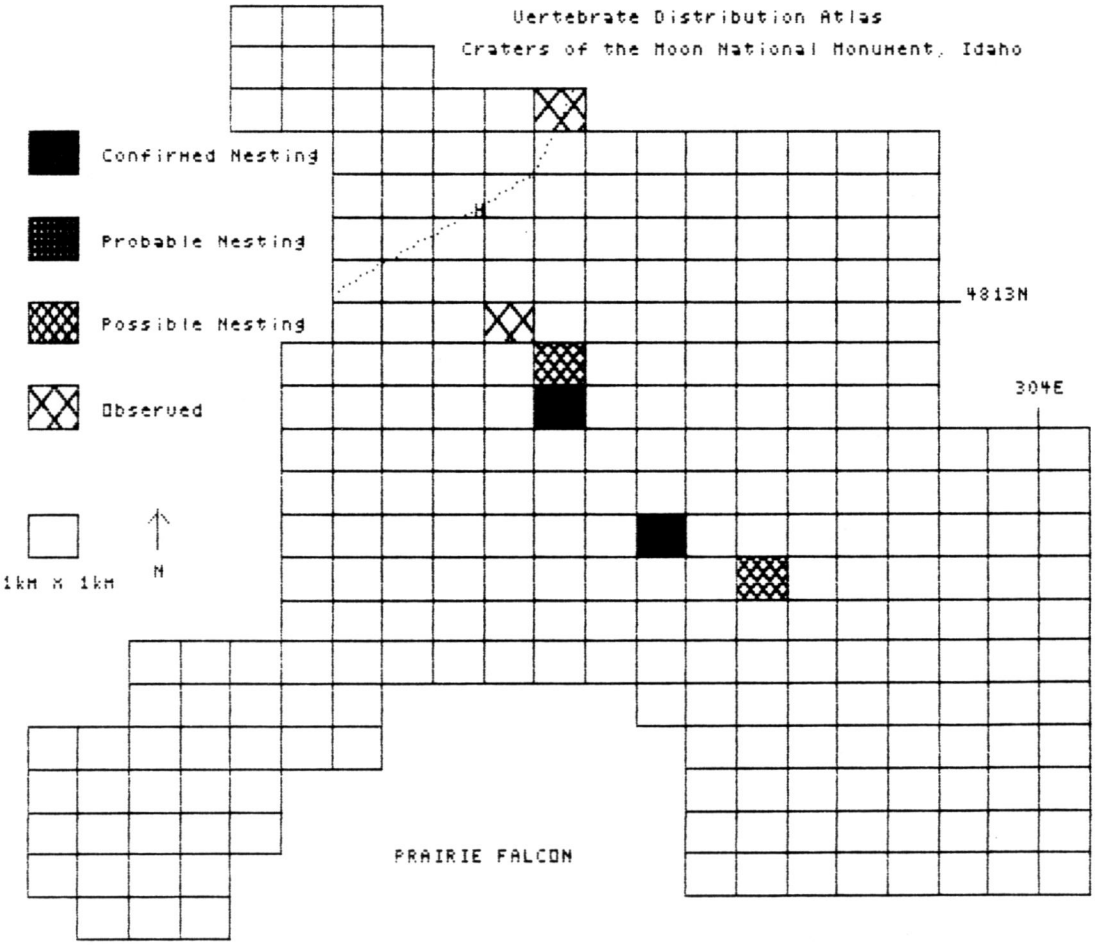

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
FERRUGINOUS HAWK

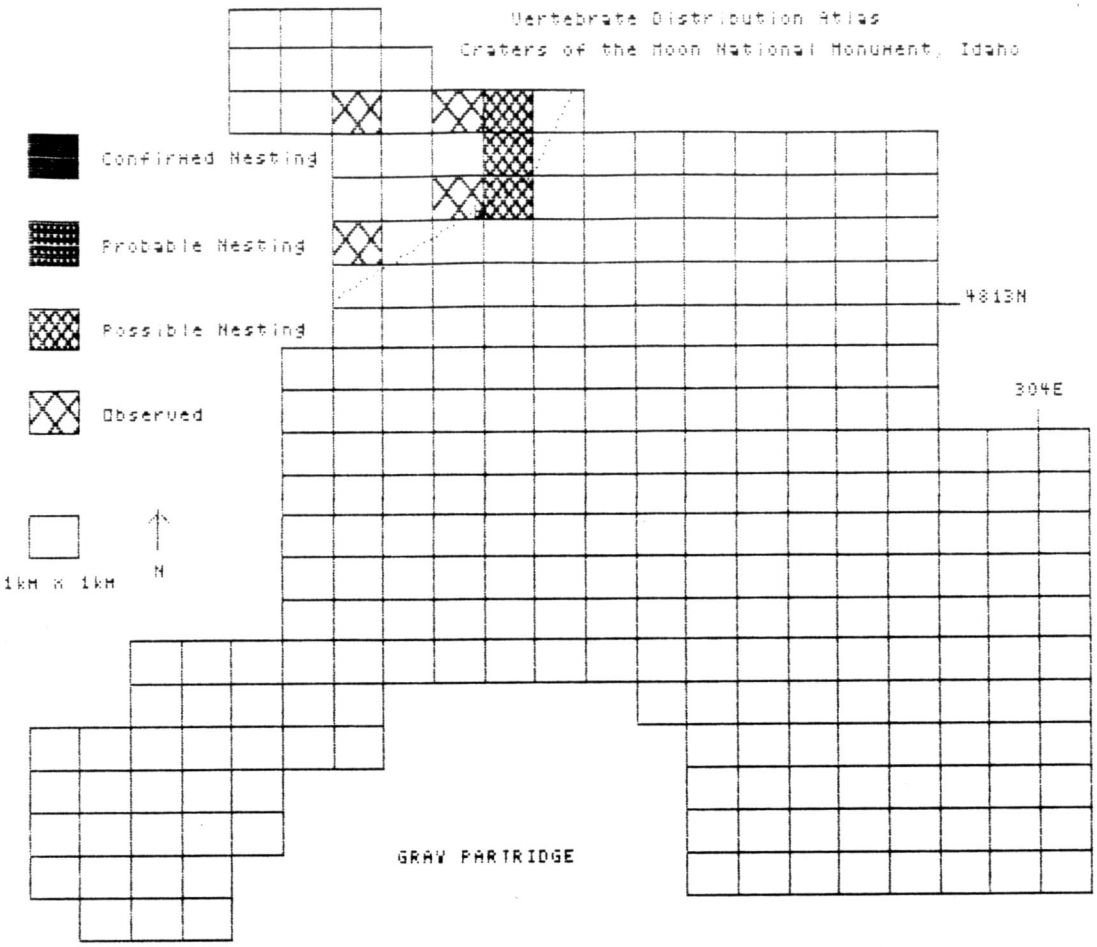

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
ROUGH-LEGGED HAWK

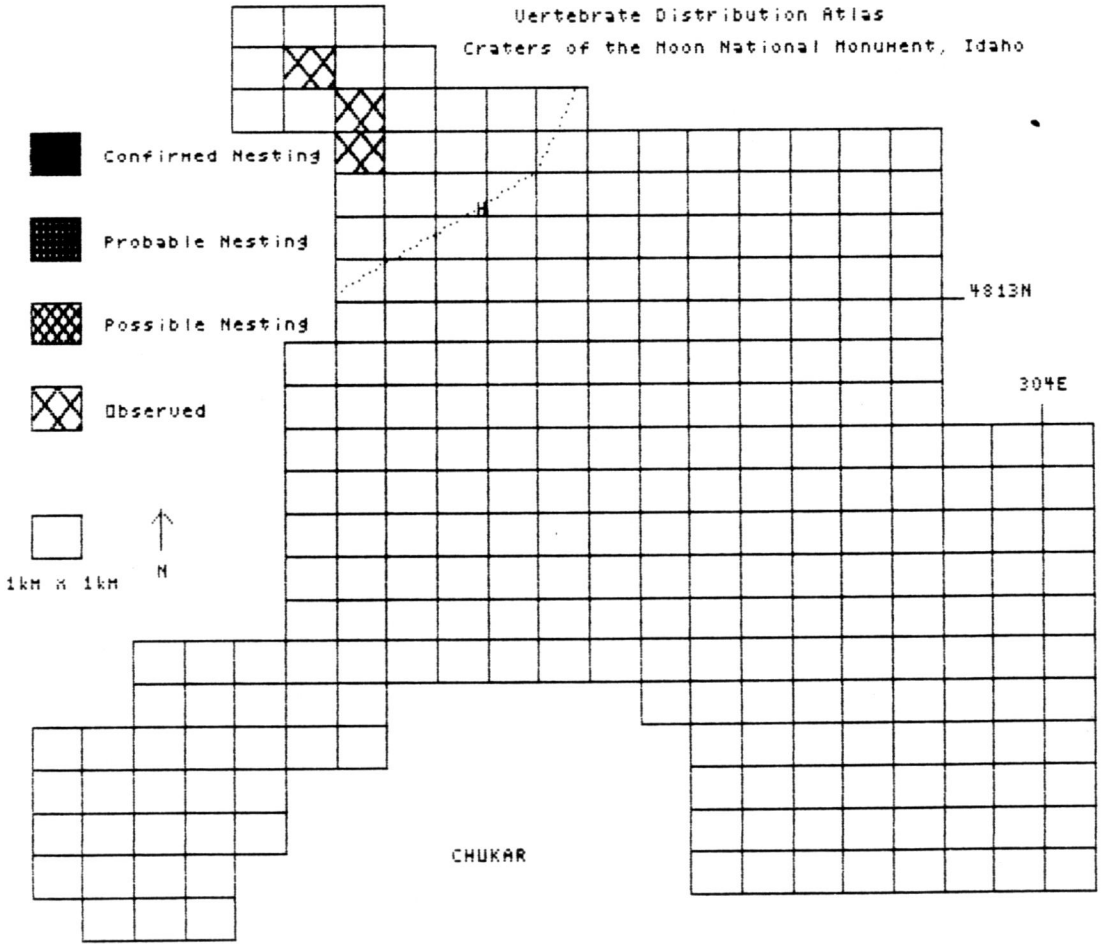

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
GOLDEN EAGLE

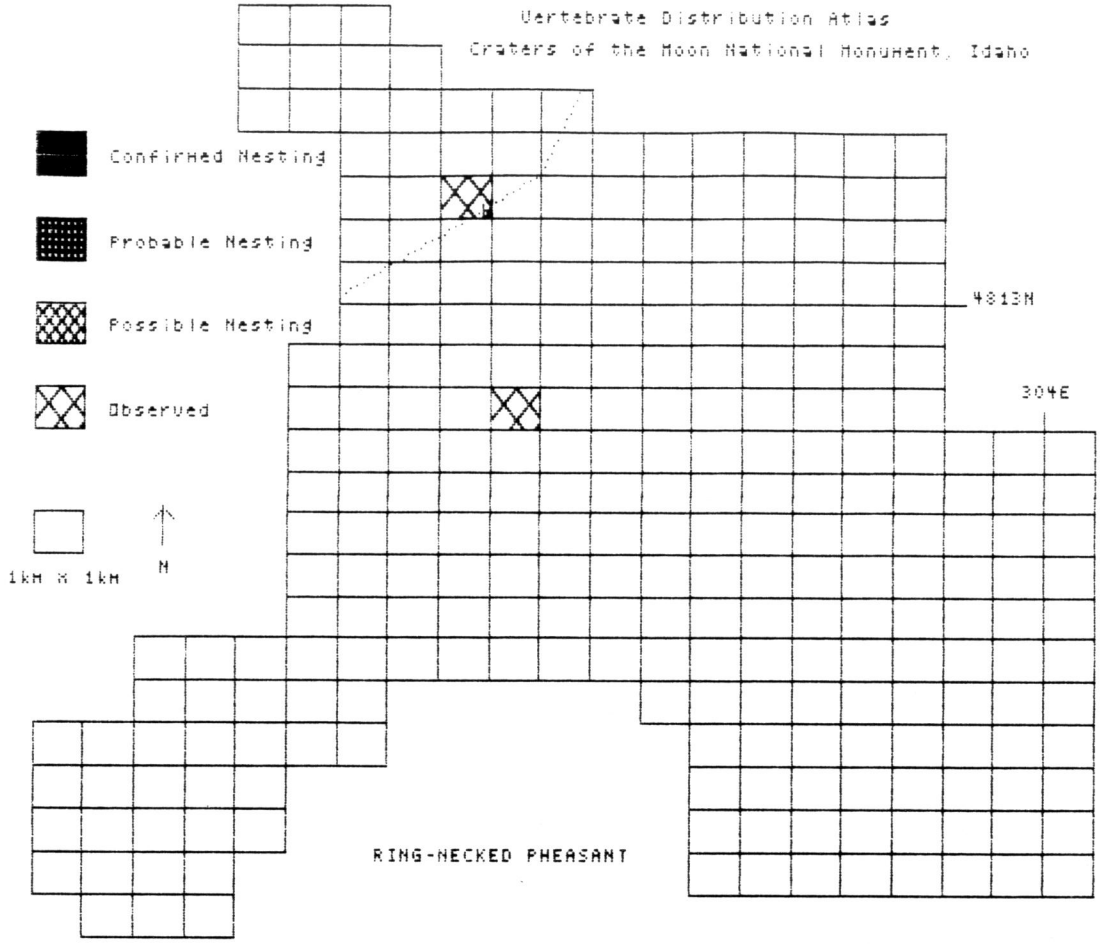

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
AMERICAN KESTREL

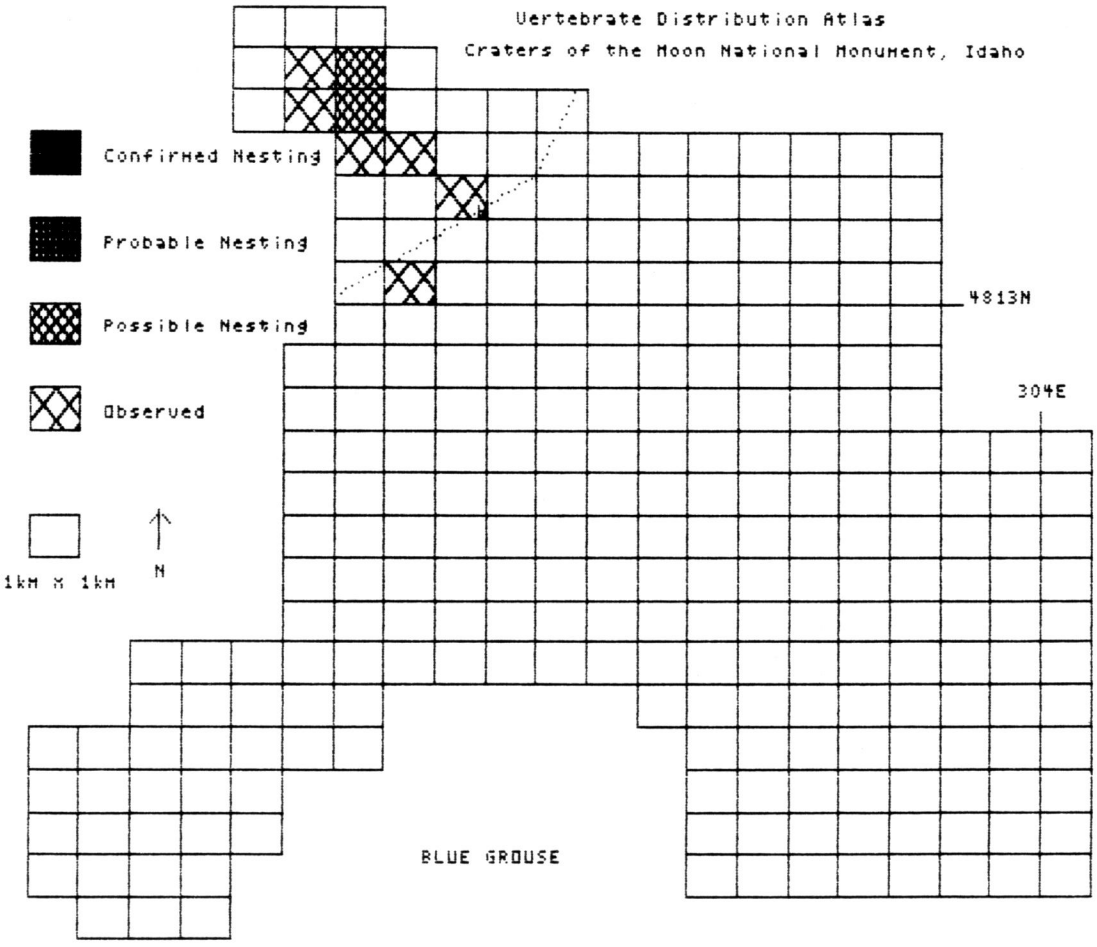

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
HERLIN

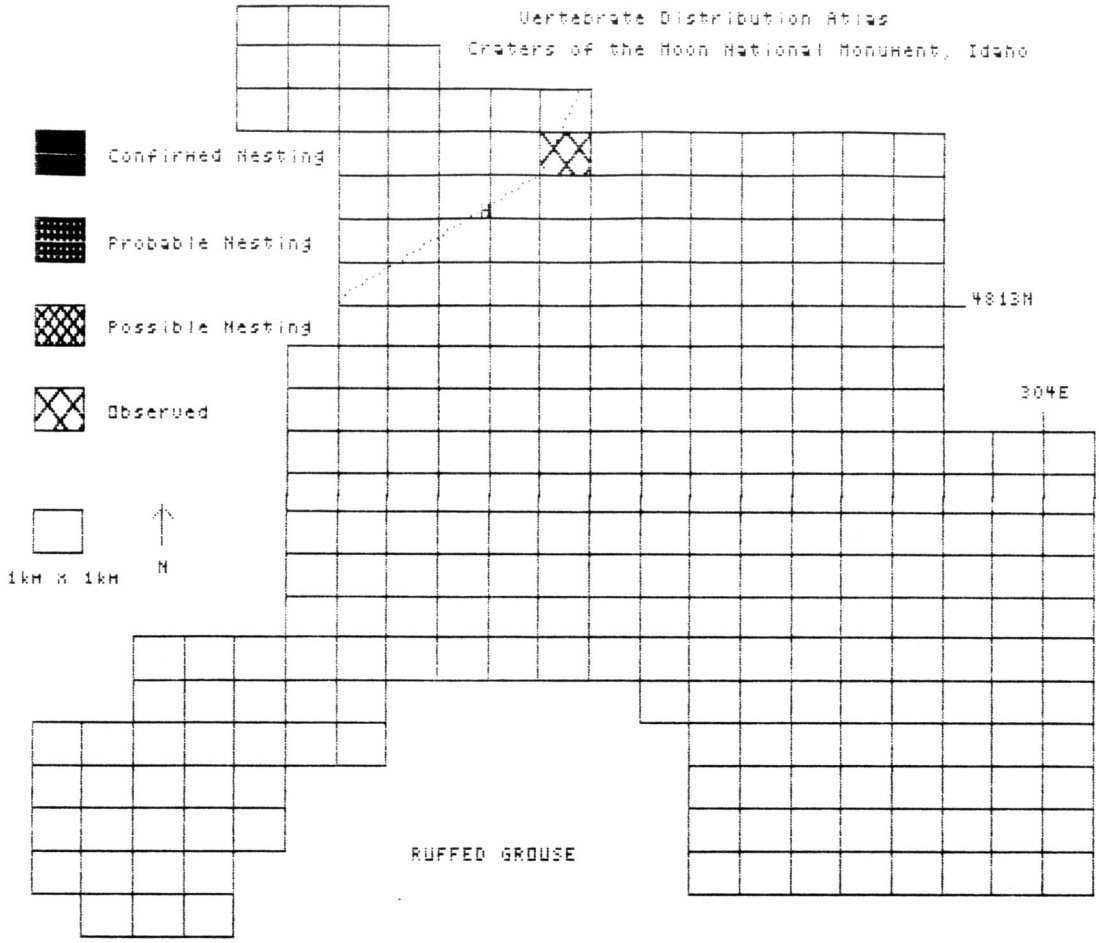

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
PRAIRIE FALCON

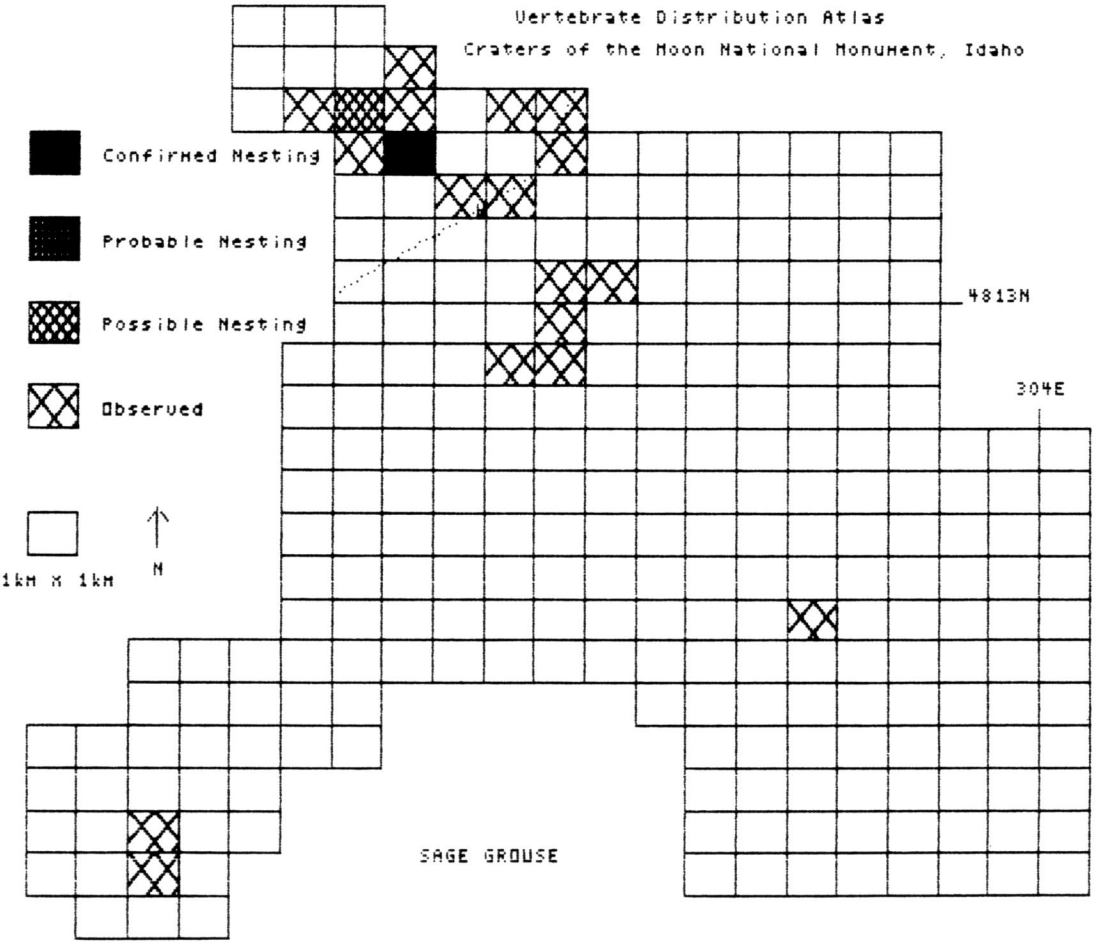

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
GRAV PARTRIDGE

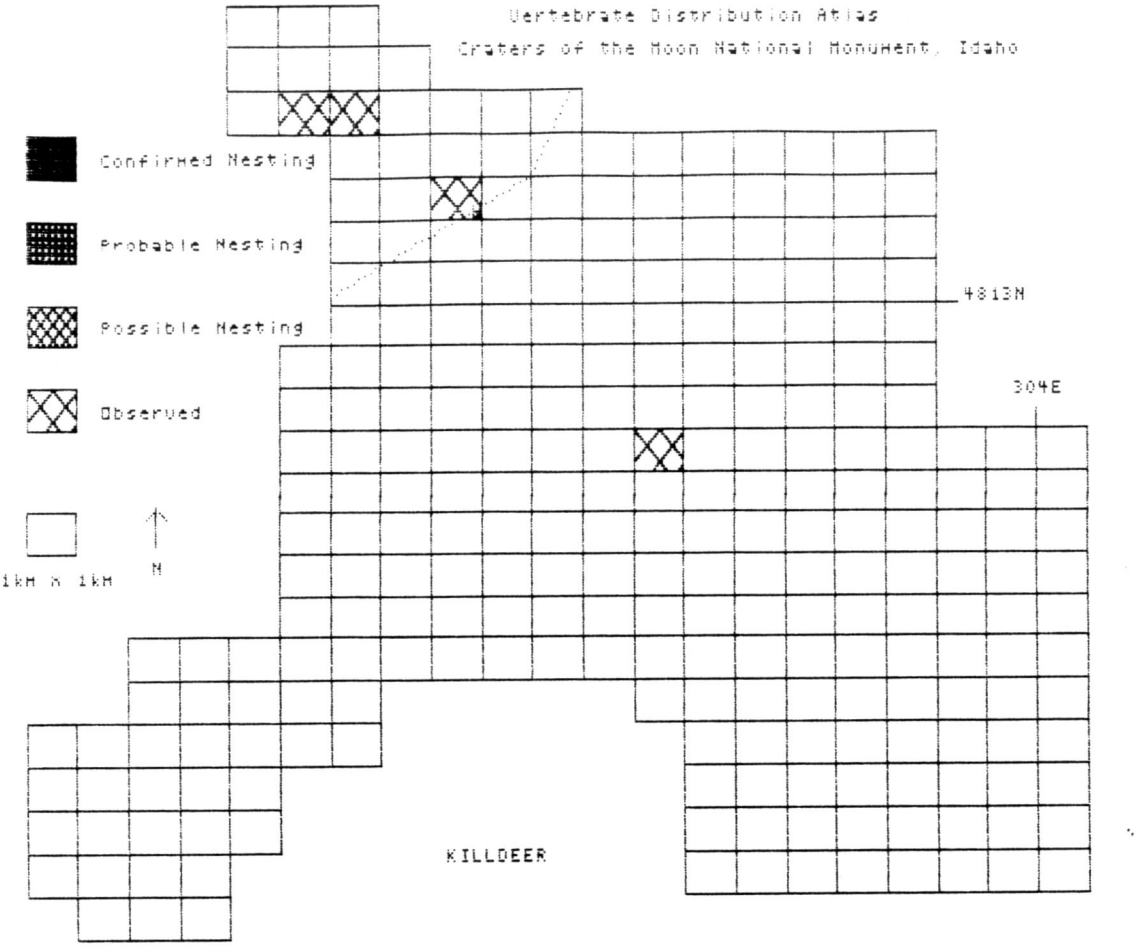

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
CHUKAR

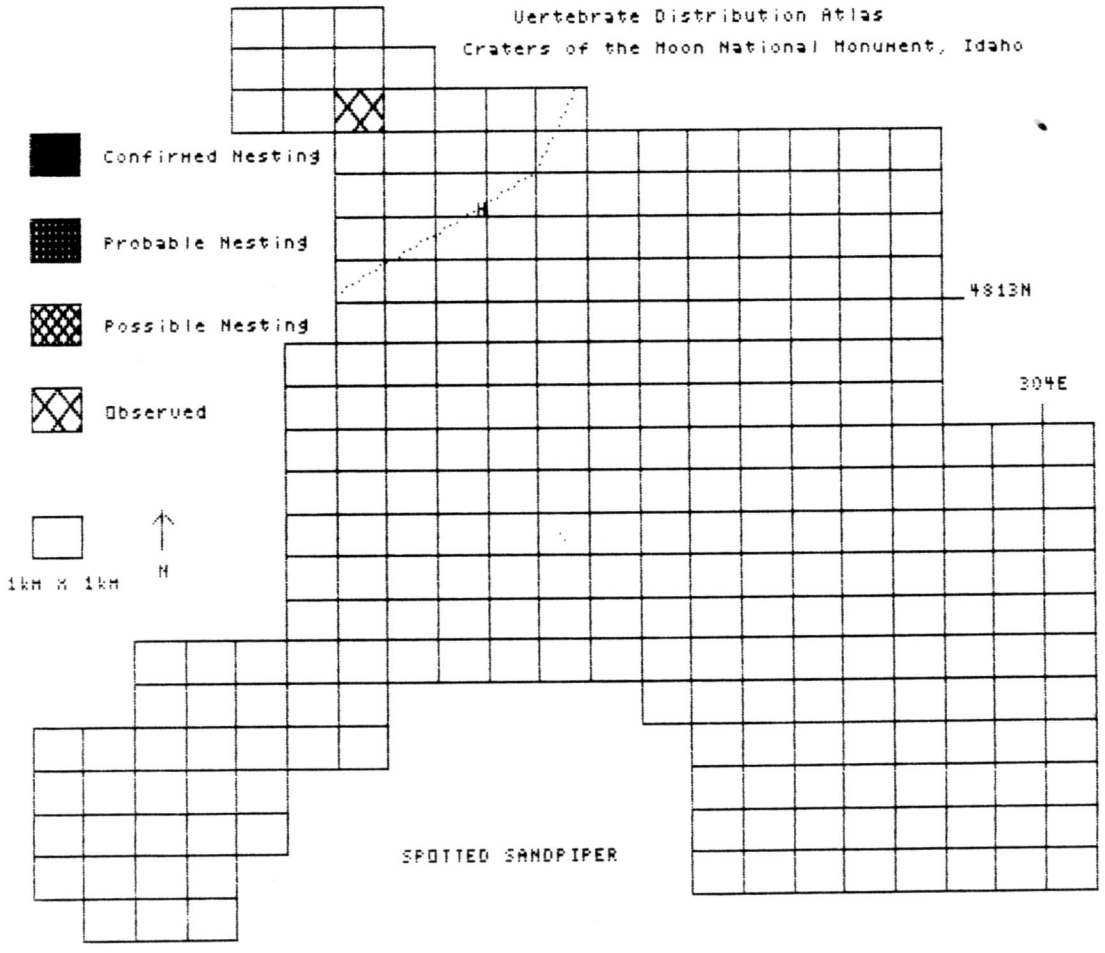

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
RING-NECKED PHEASANT

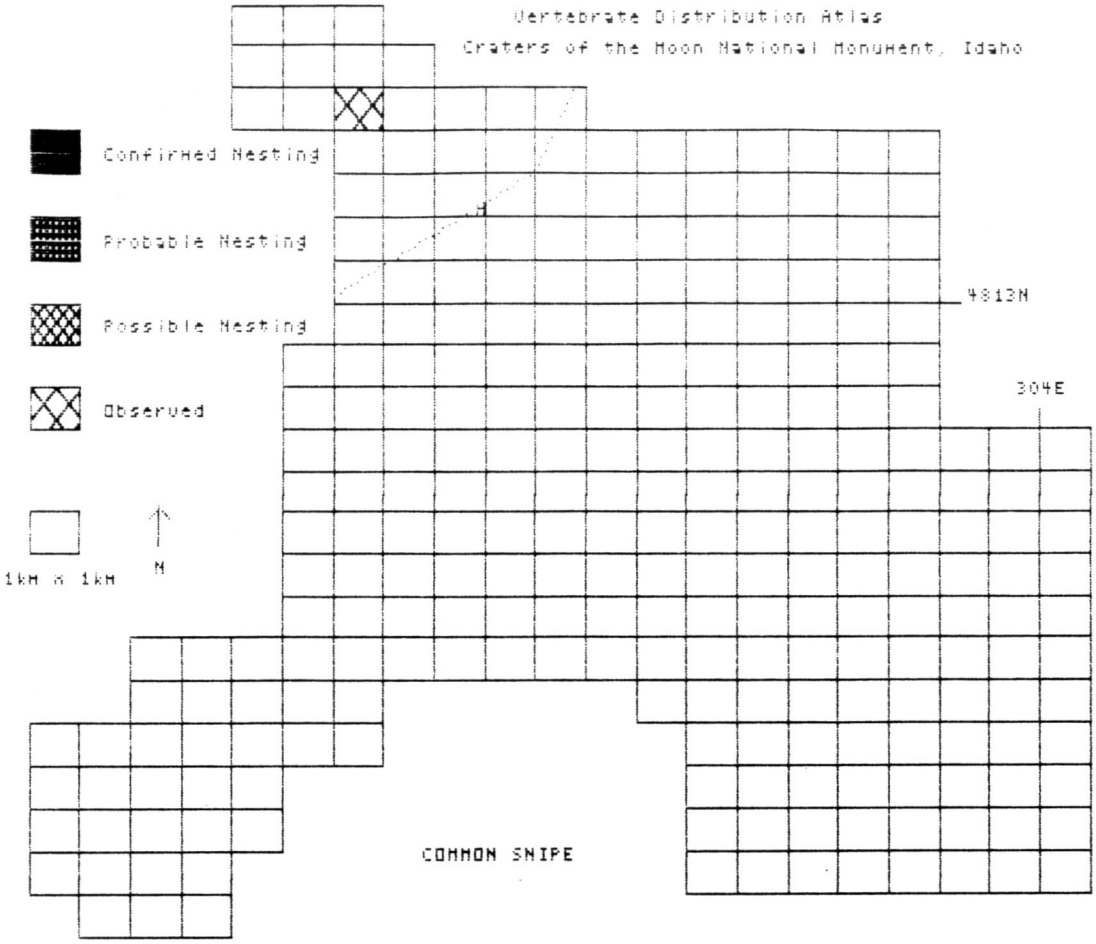

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
BLUE GROUSE

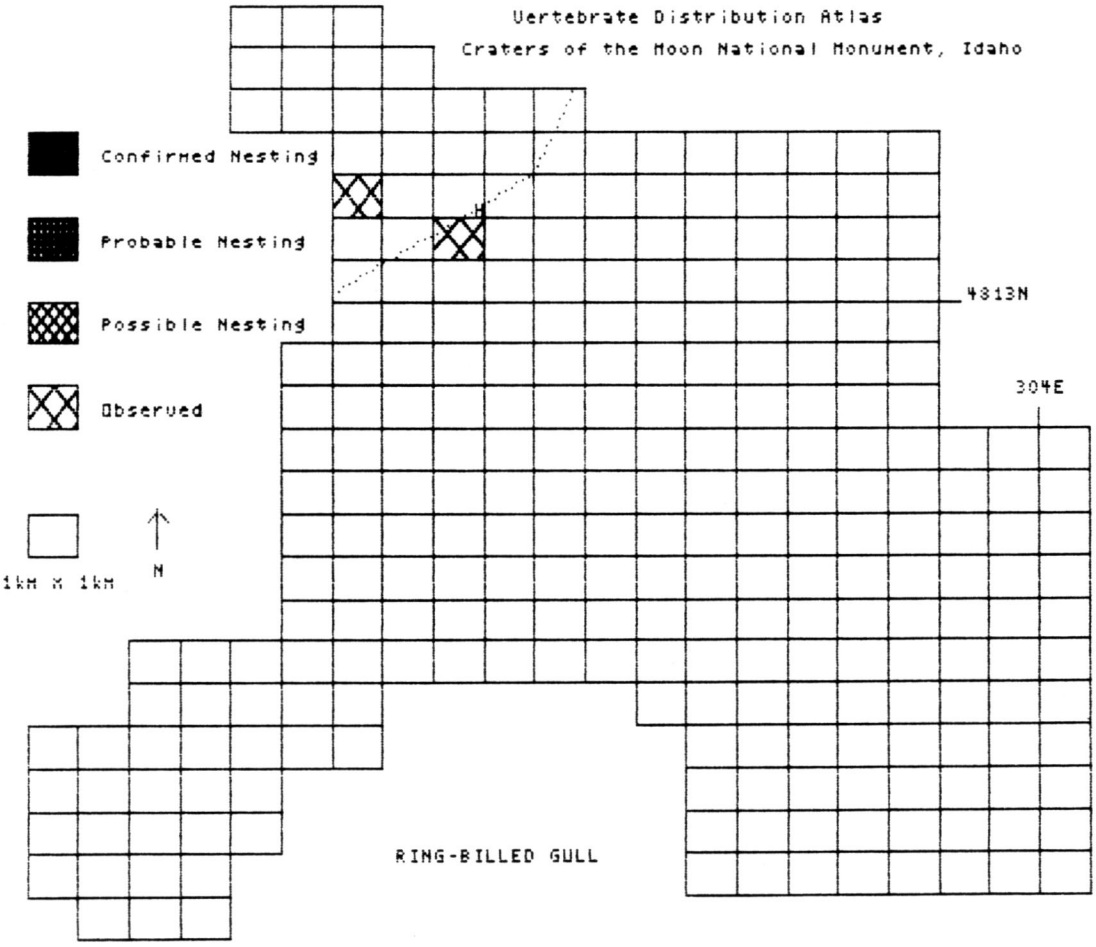

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
RUFFED GROUSE

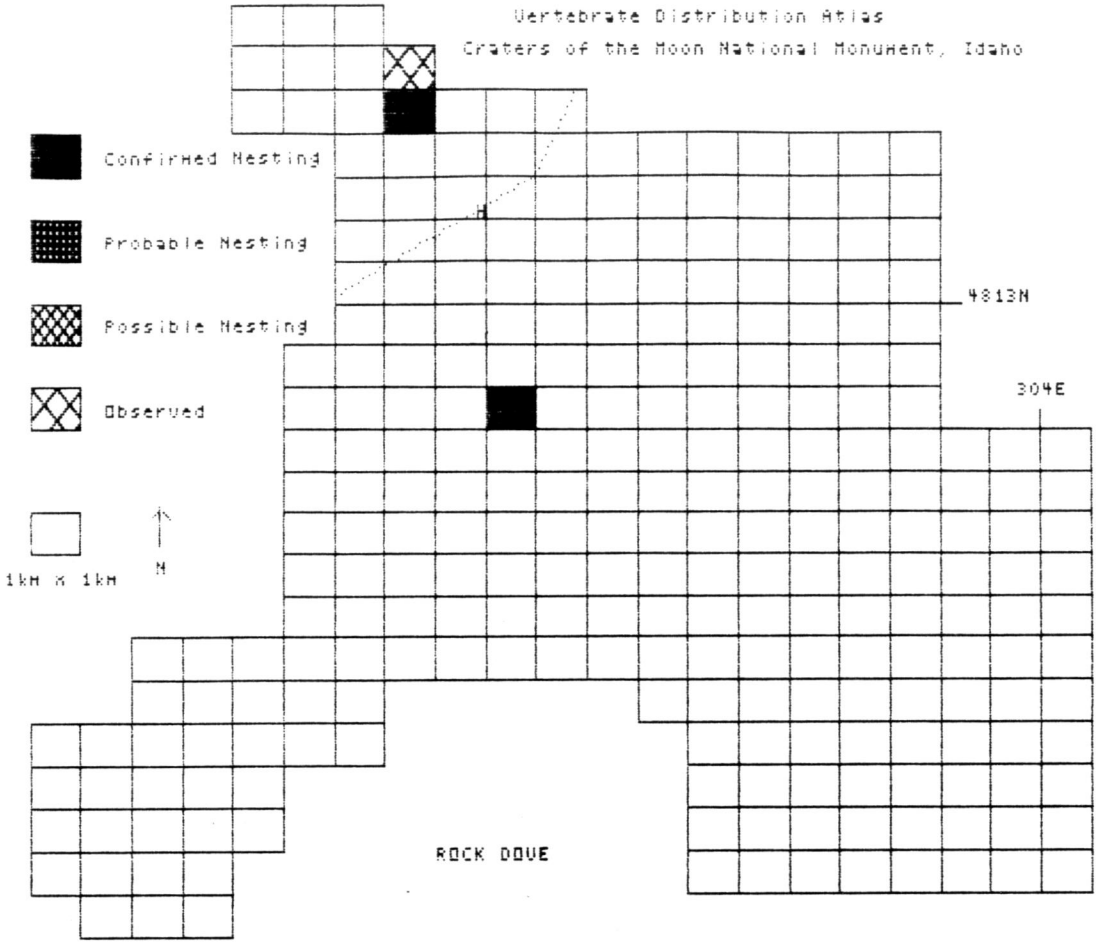

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
SAGE GROUSE

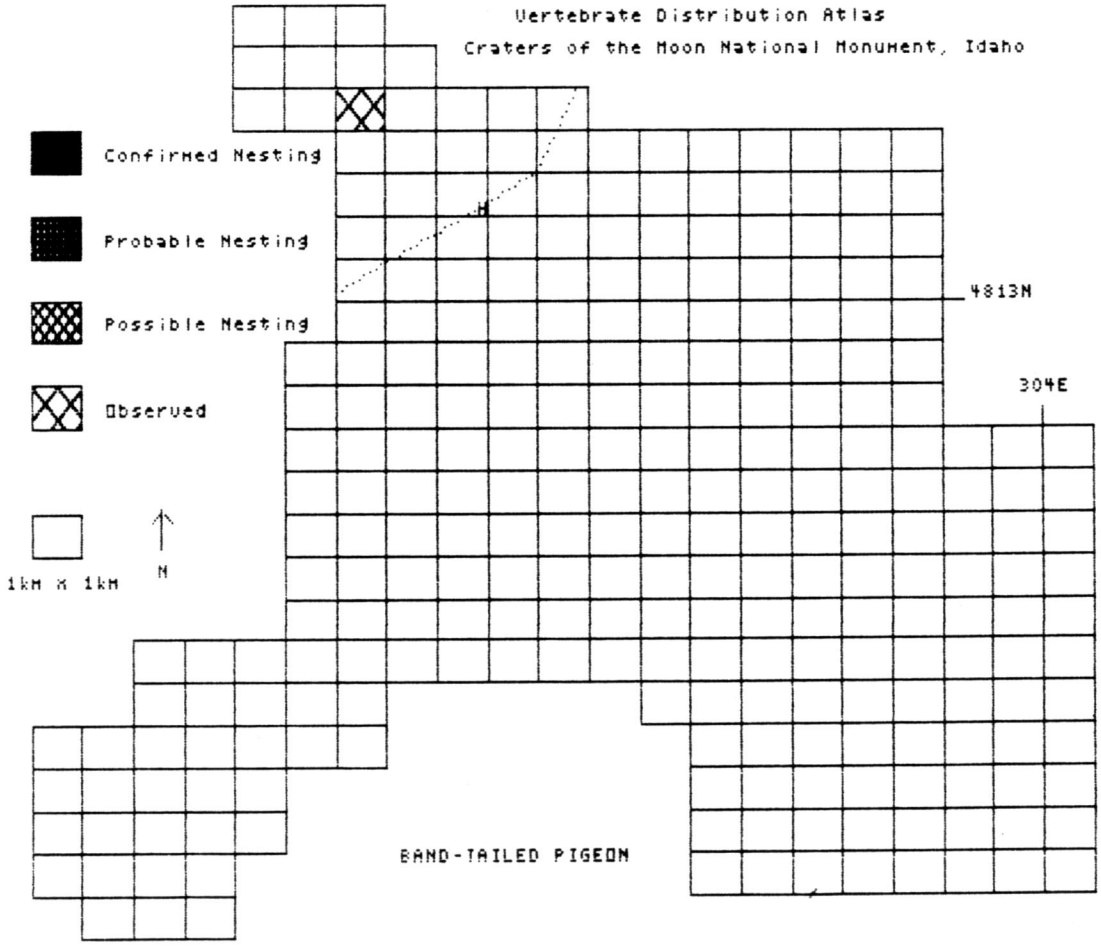

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
KILLDEER

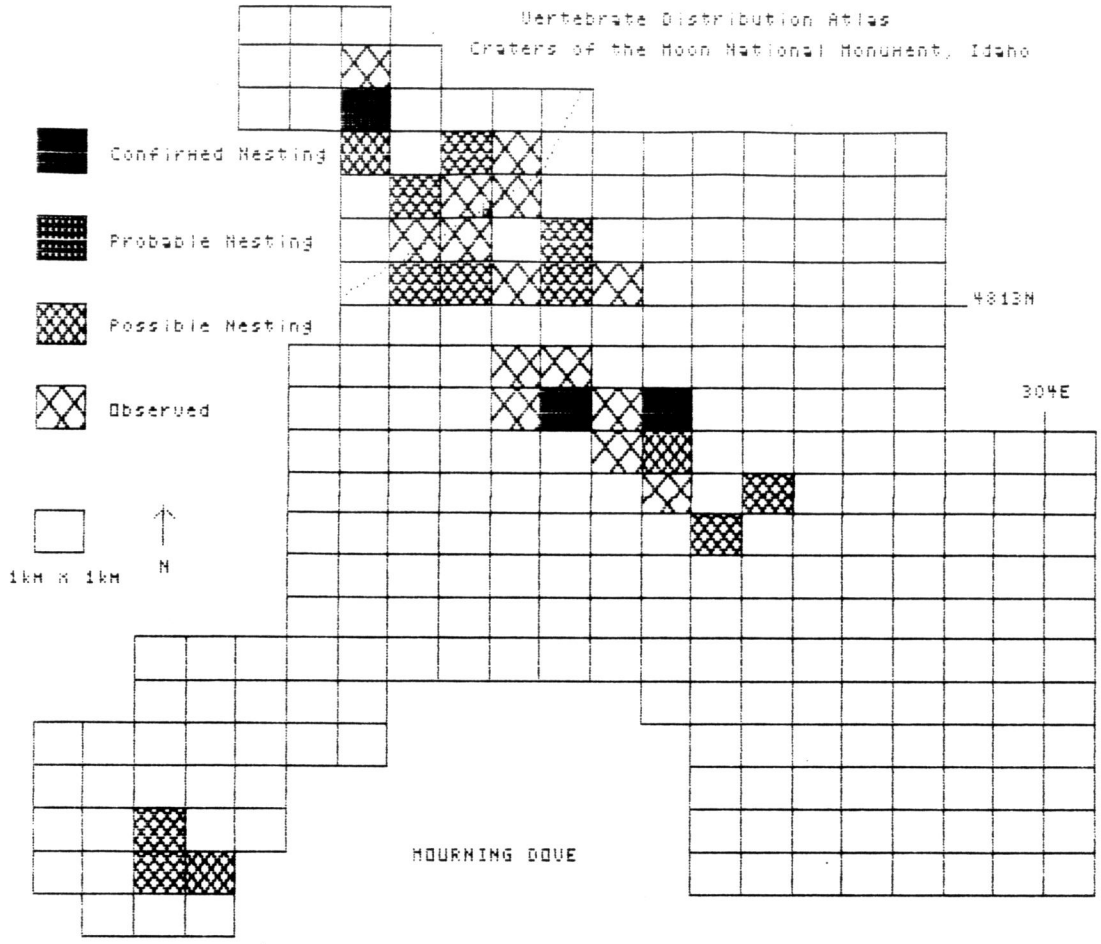

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
SPOTTED SANDPIPER

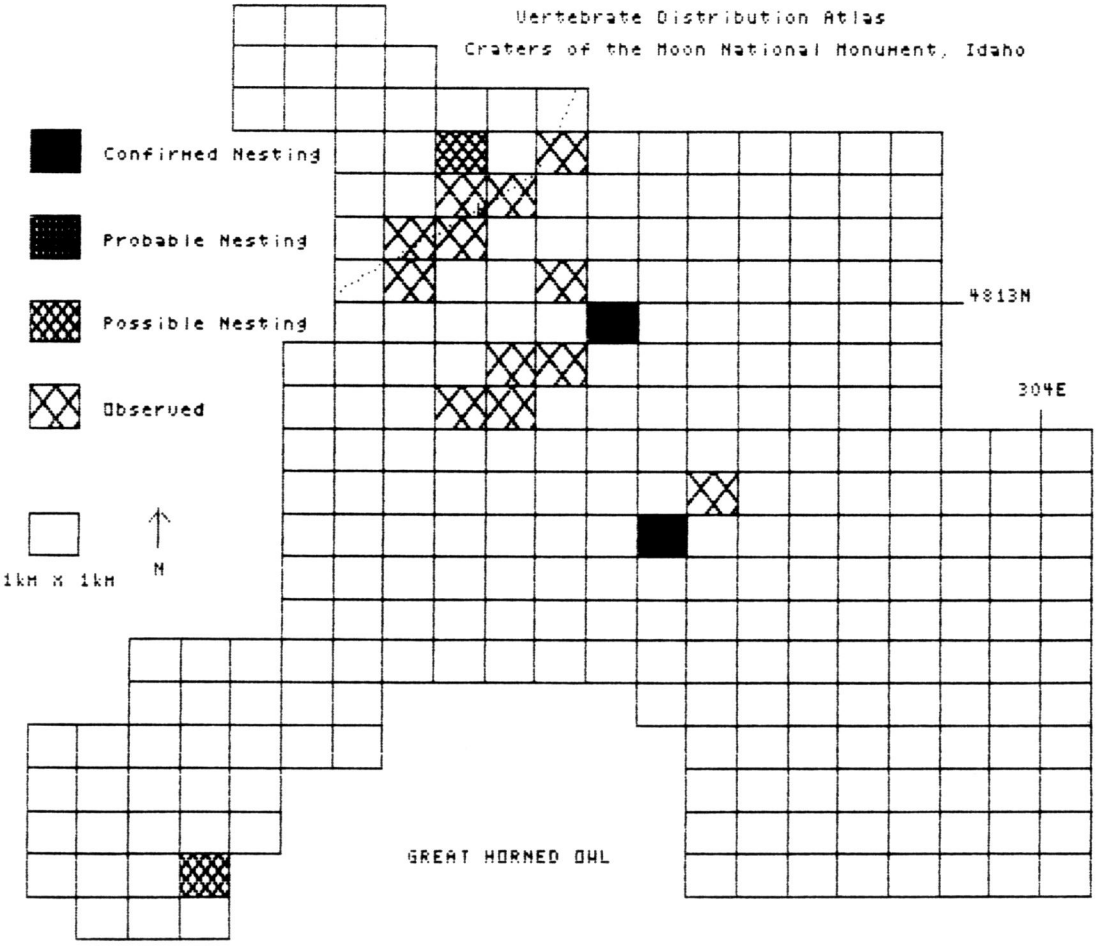

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
COMMON SNIPE

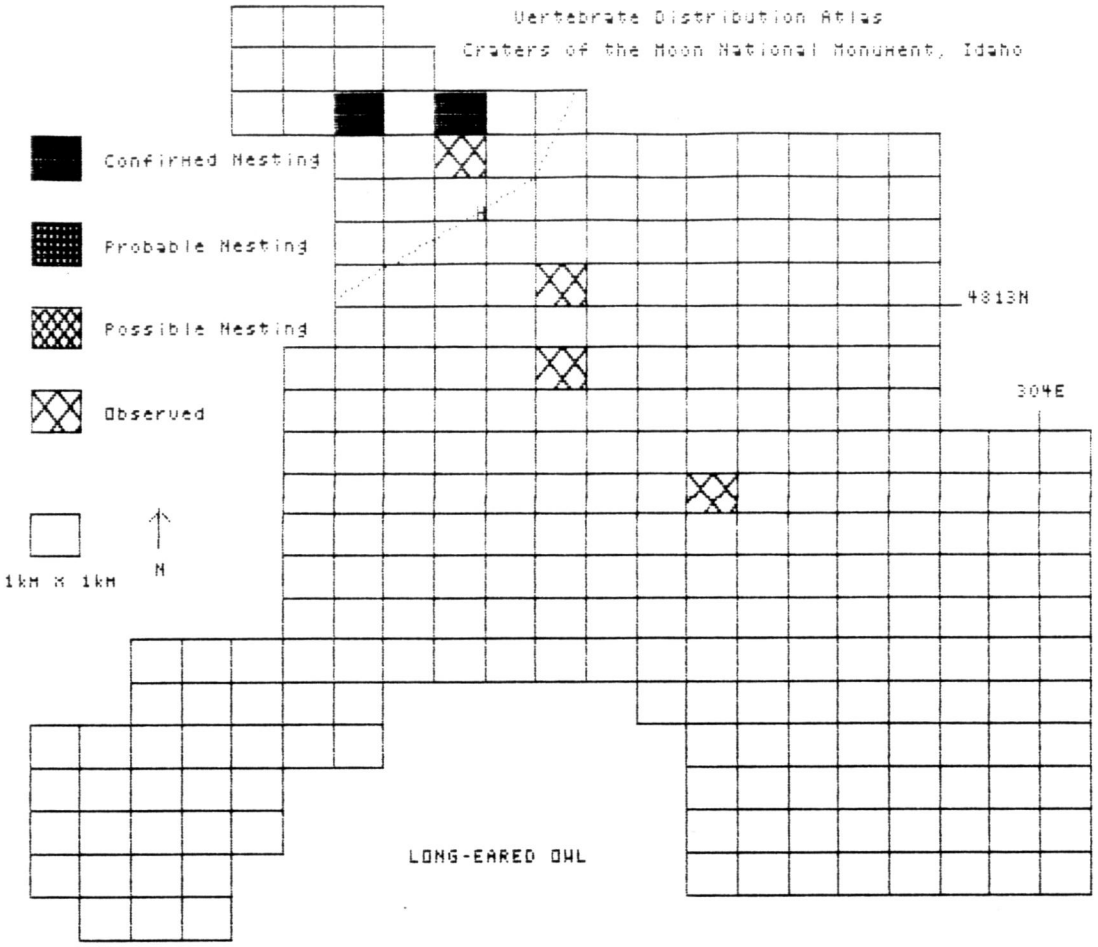

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
RING-BILLED GULL

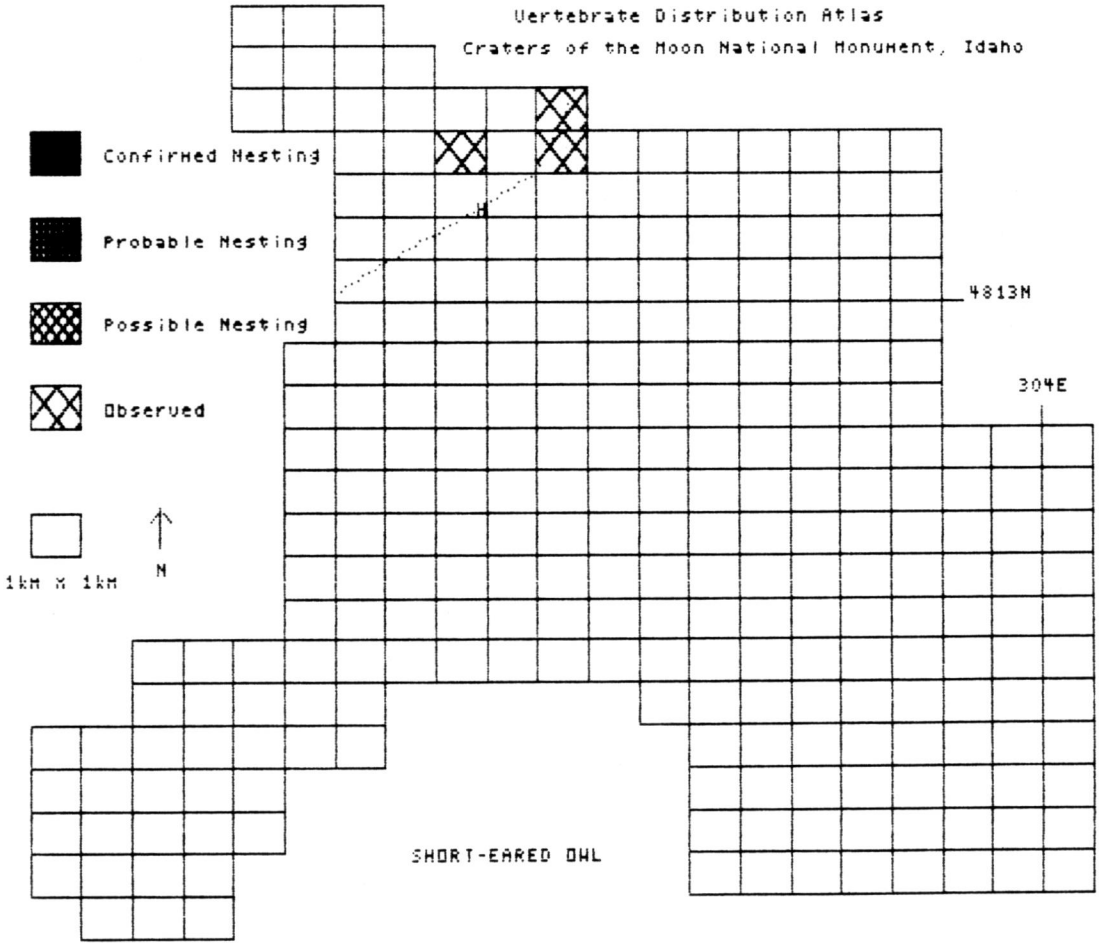

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
ROCK DOVE

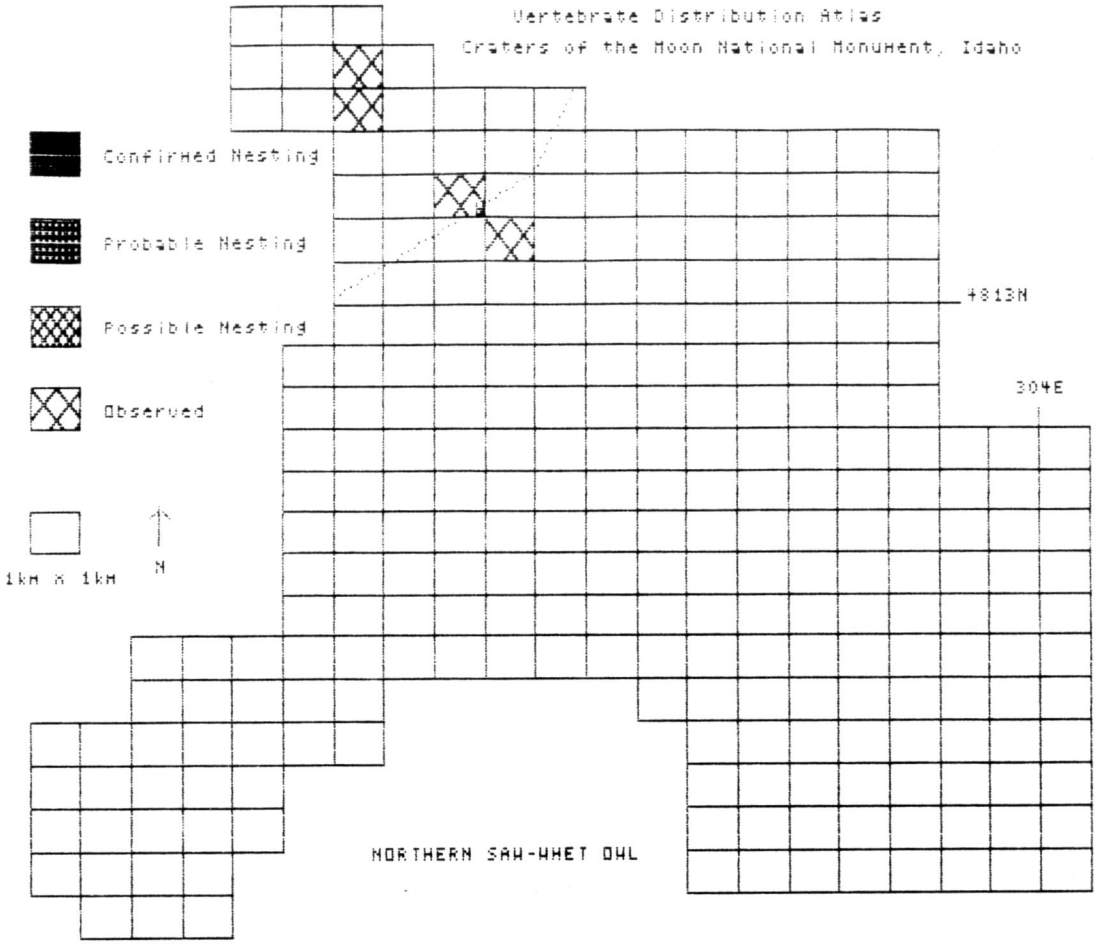

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
BAND-TAILED PIGEON

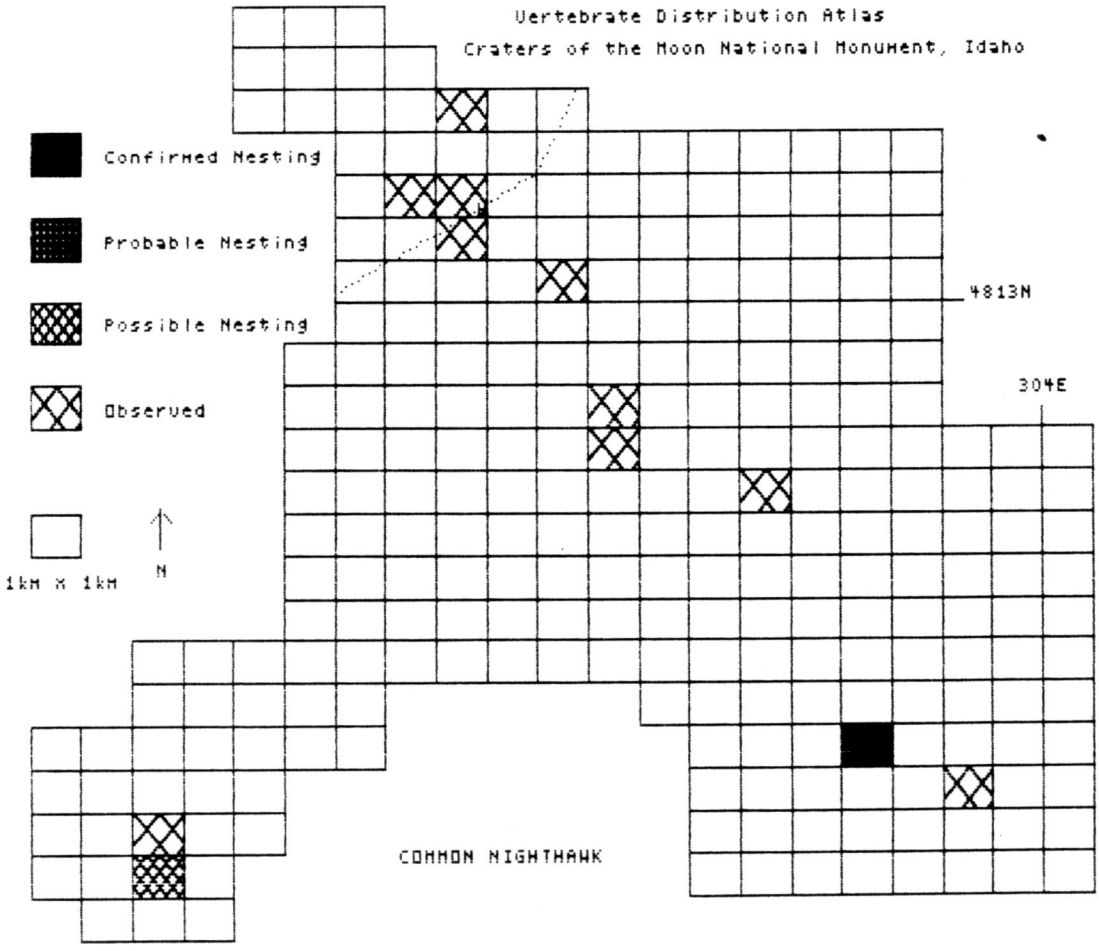

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
MOURNING DOVE

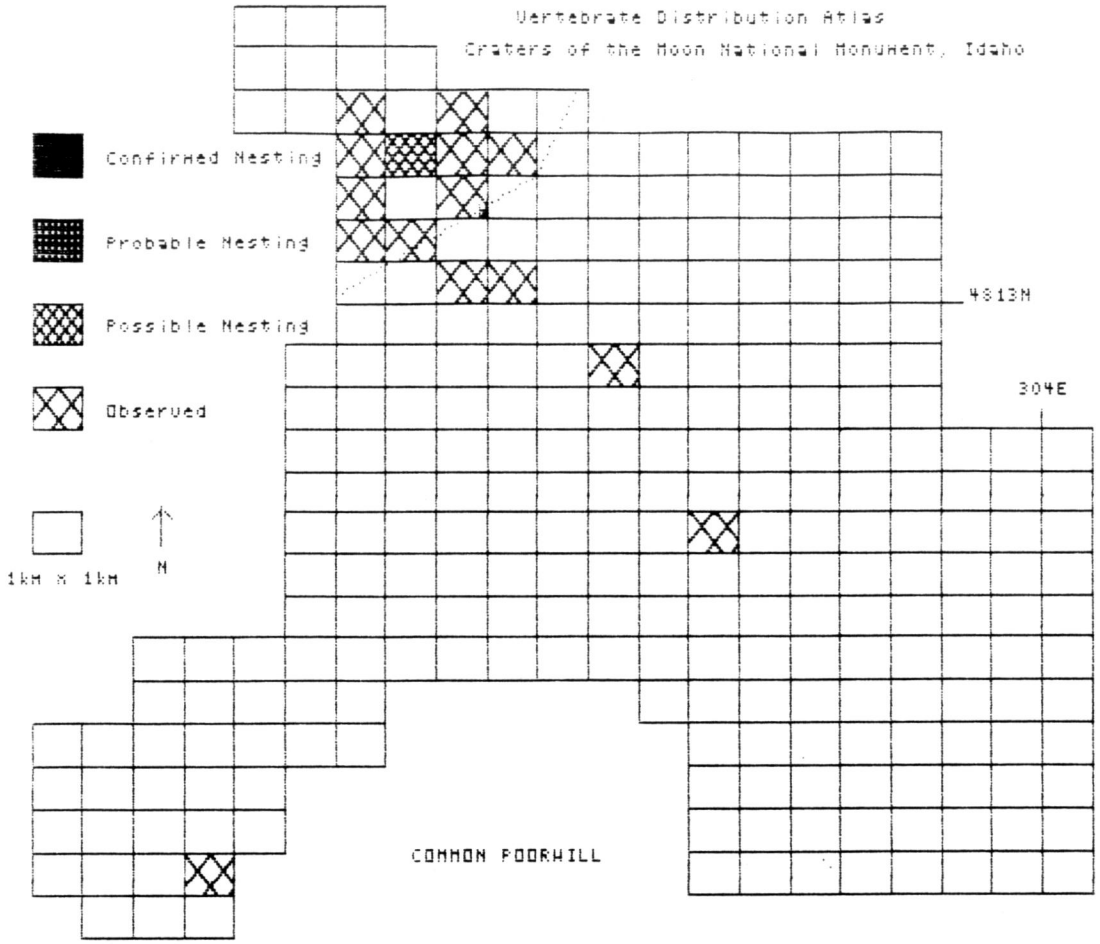

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
GREAT HORNED OWL

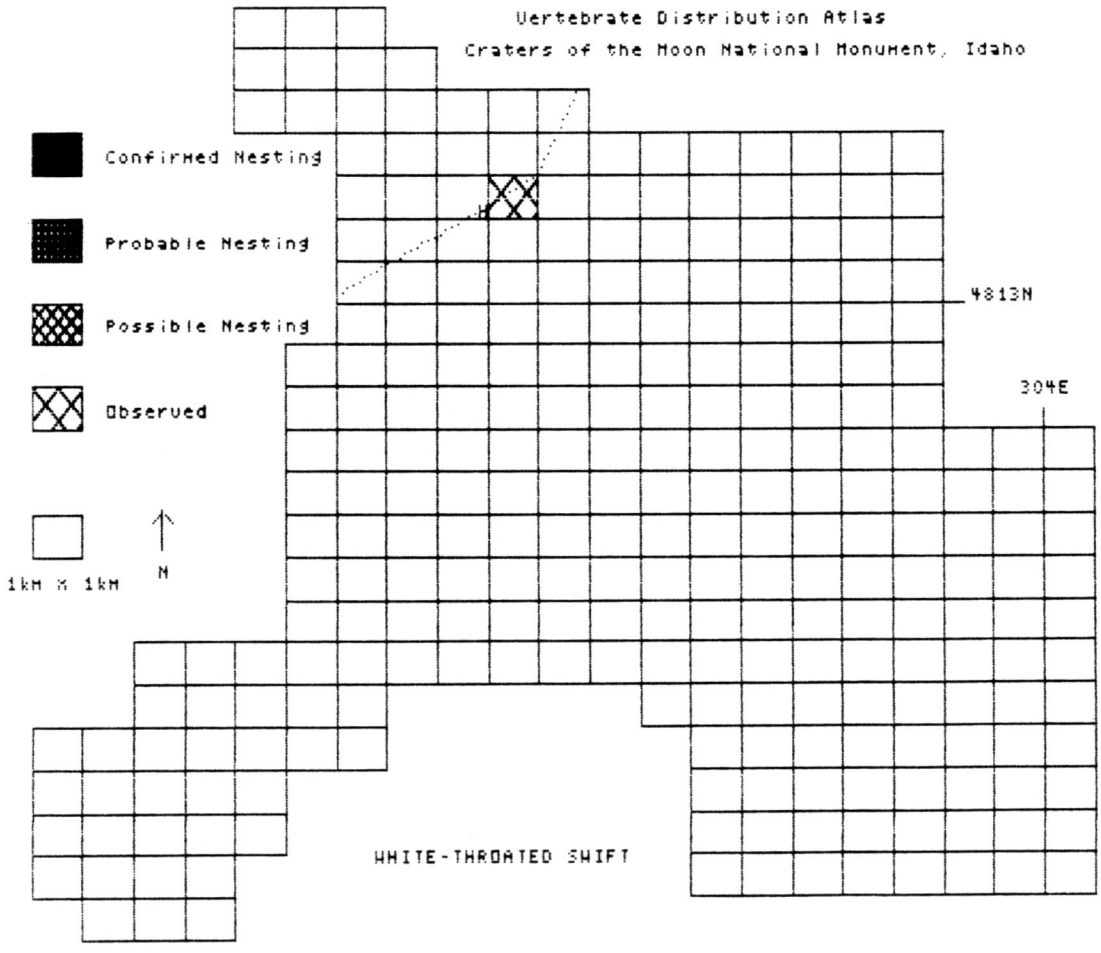

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
LONG-EARED OWL

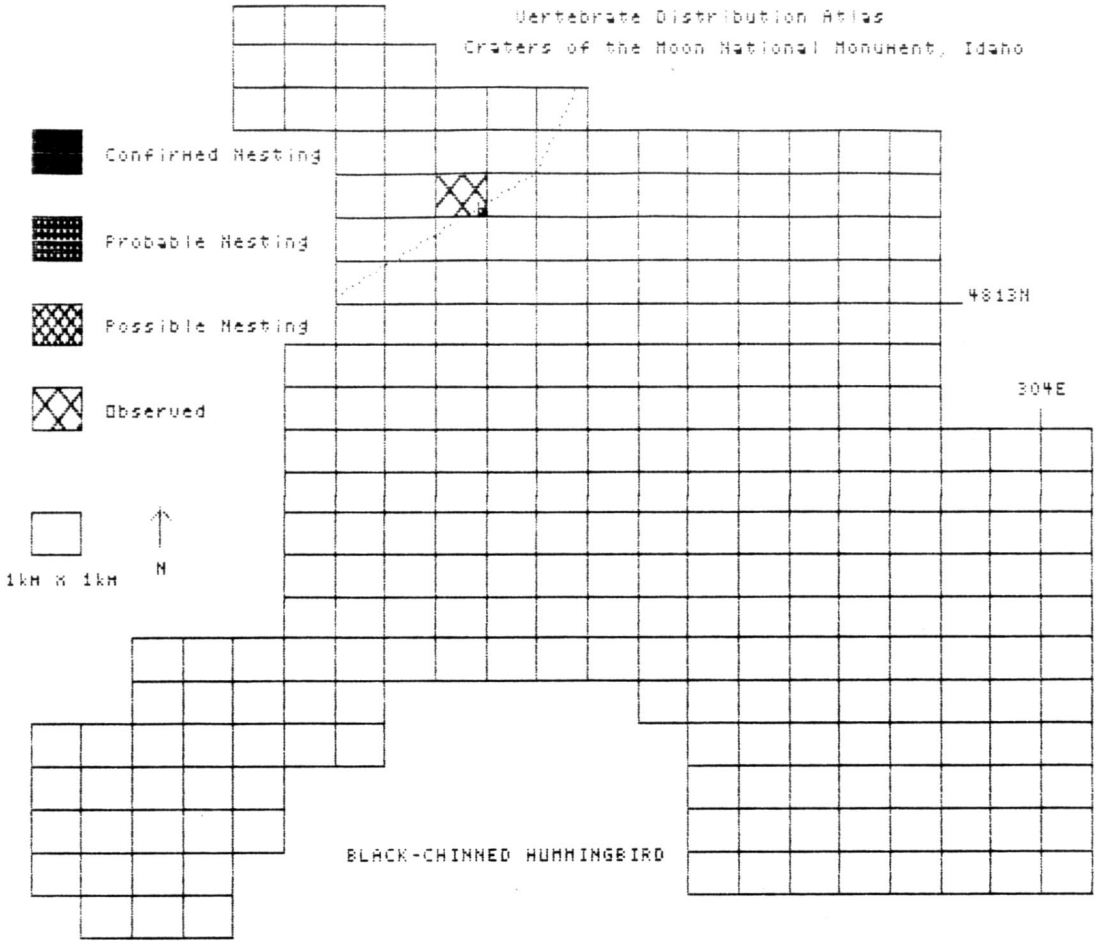

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
SHORT-EARED OWL

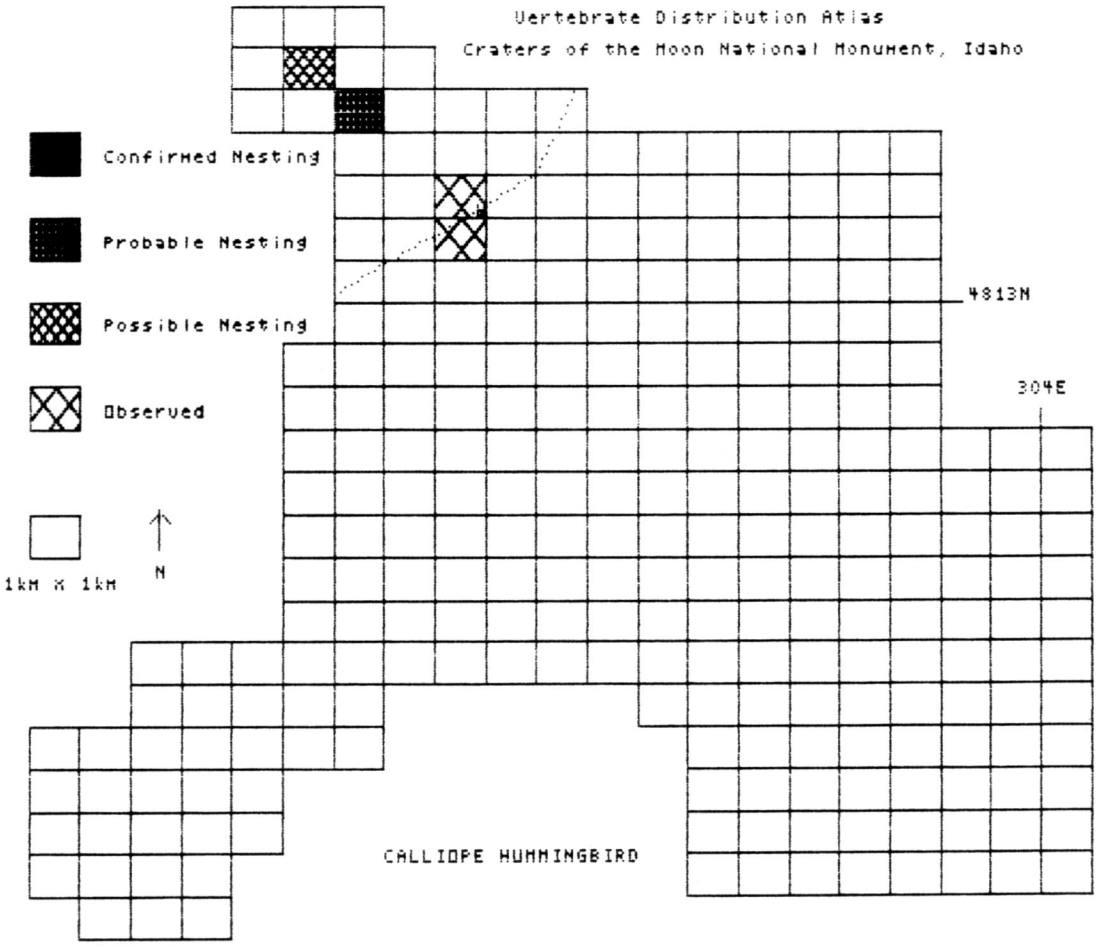

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
NORTHERN SAW-WHET OWL

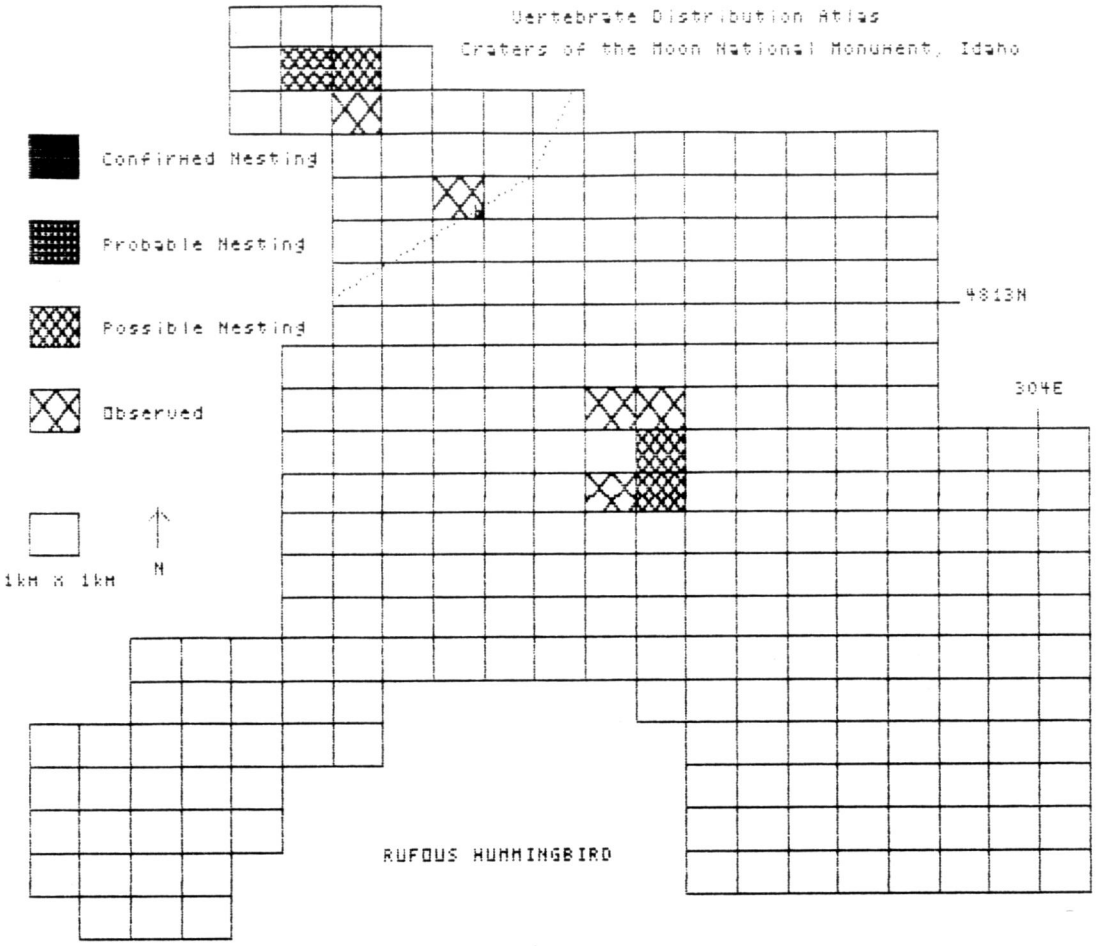

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
COMMON NIGHTHAWK

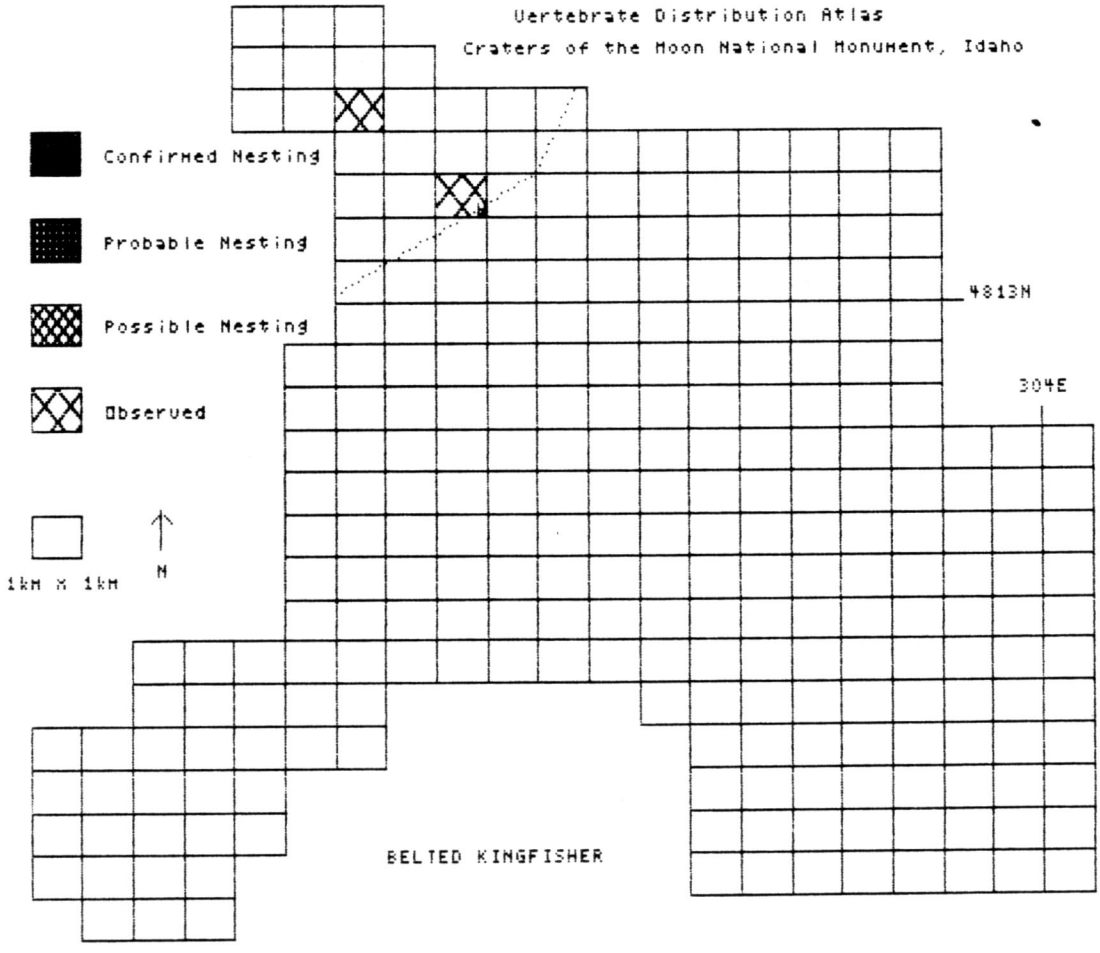

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
COMMON POORWILL

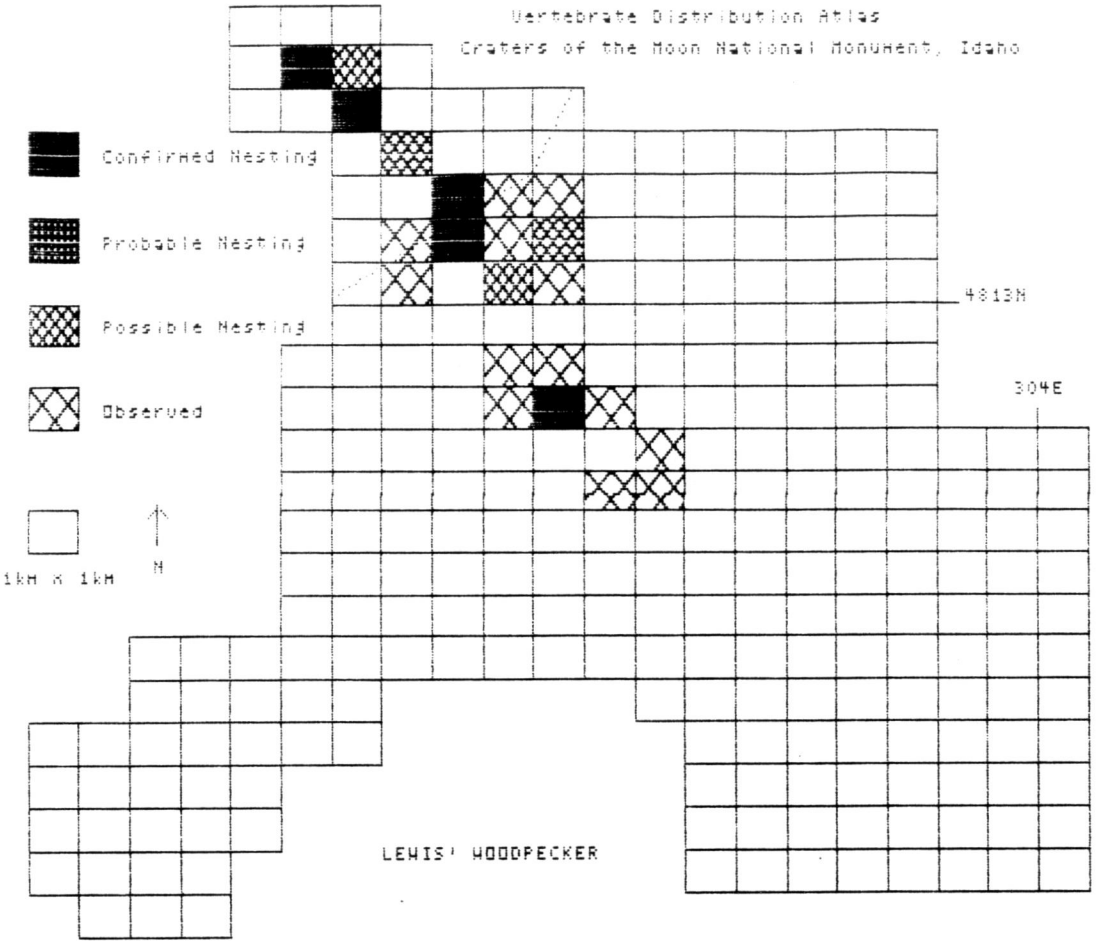

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WHITE-THROATED SWIFT

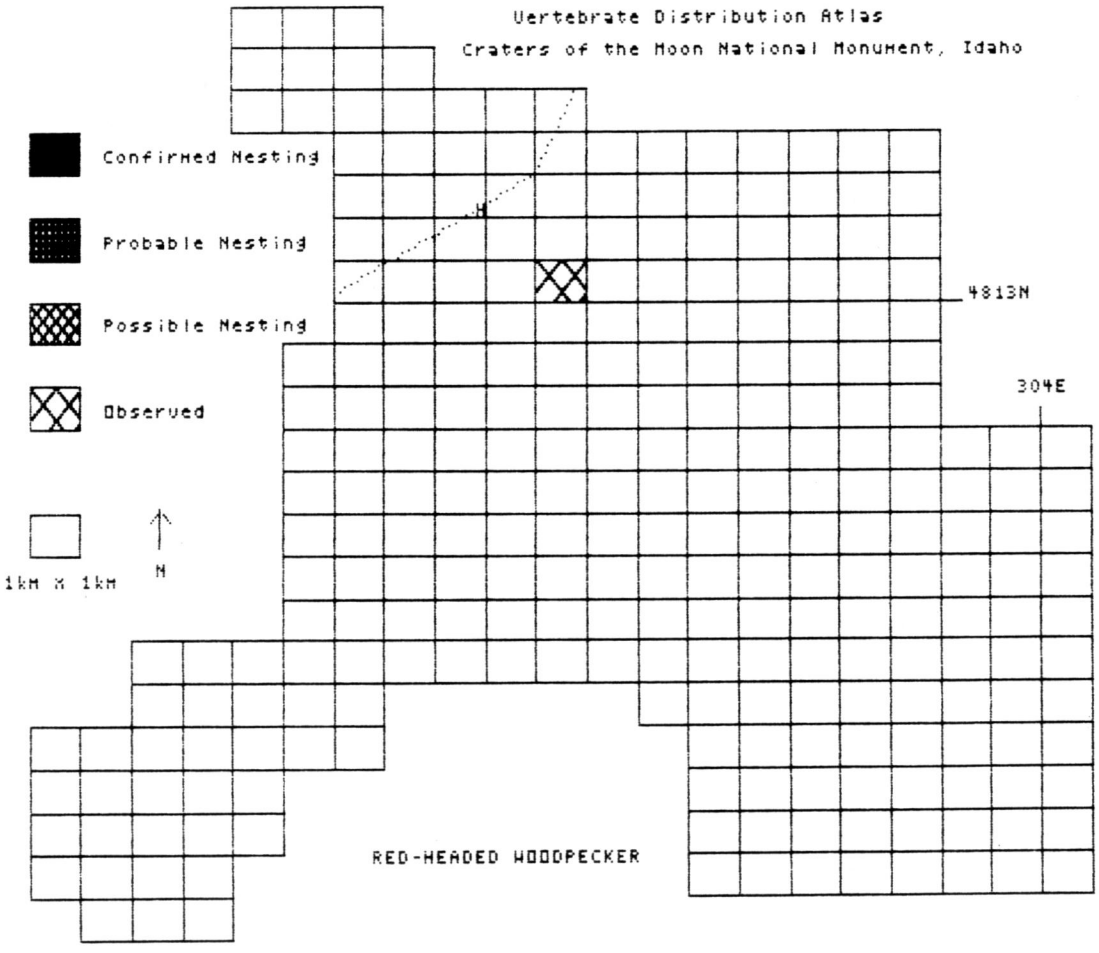

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
BLACK-CHINNED HUMMINGBIRD

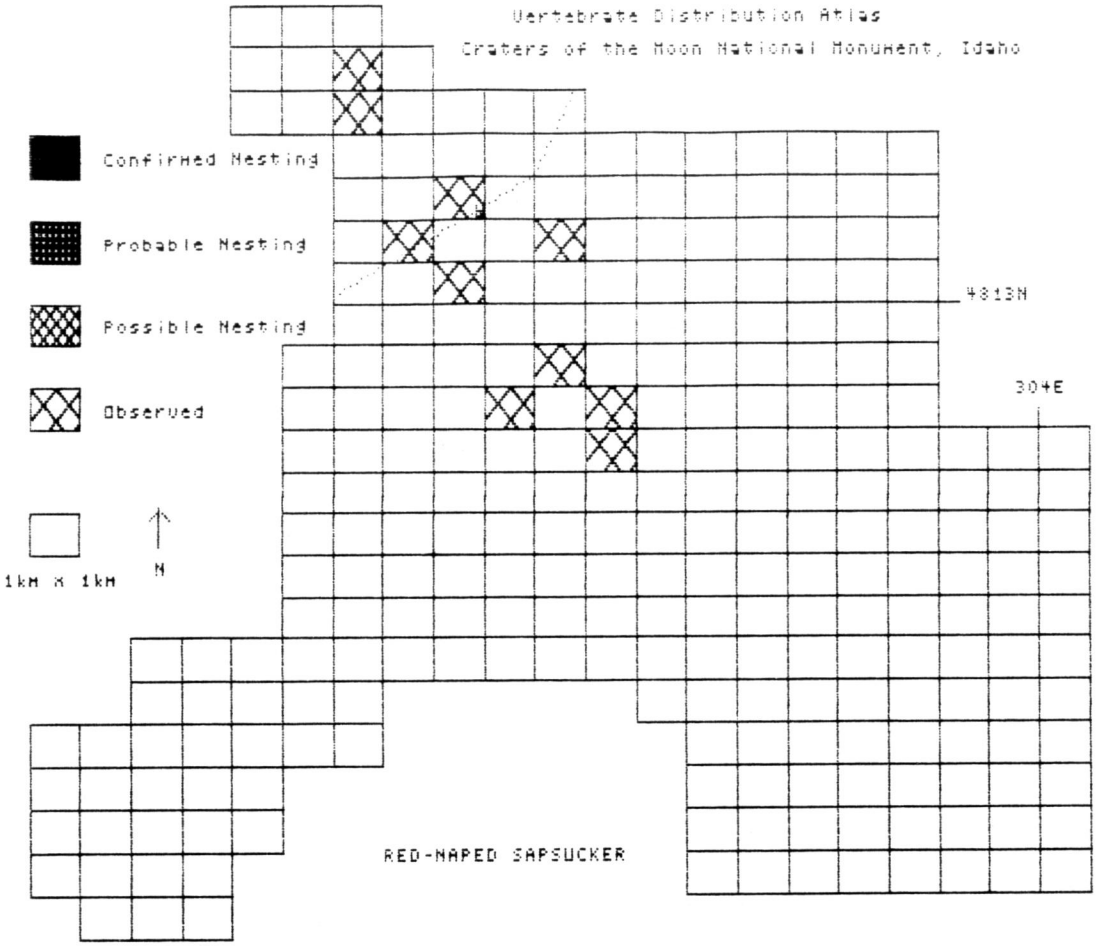

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
CALLIOPE HUMMINGBIRD

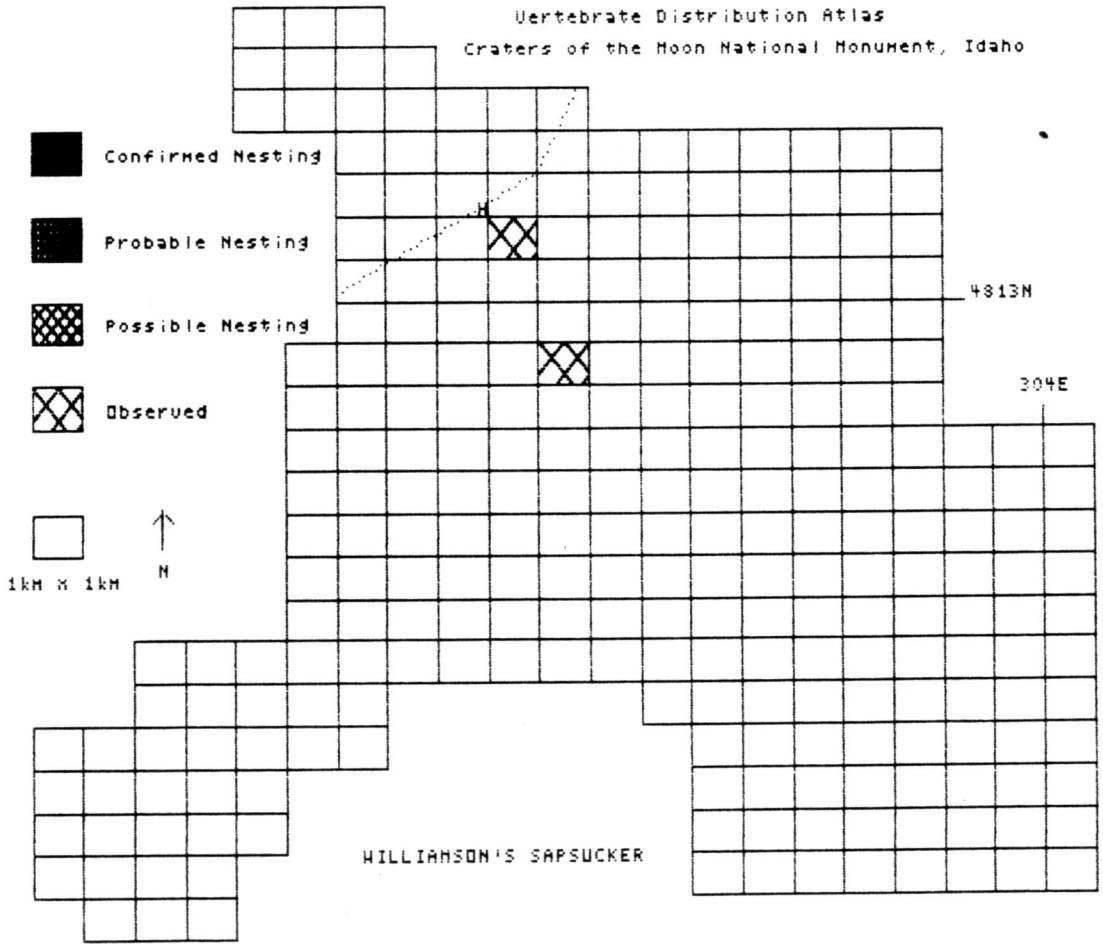

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
RUFOUS HUMMINGBIRD

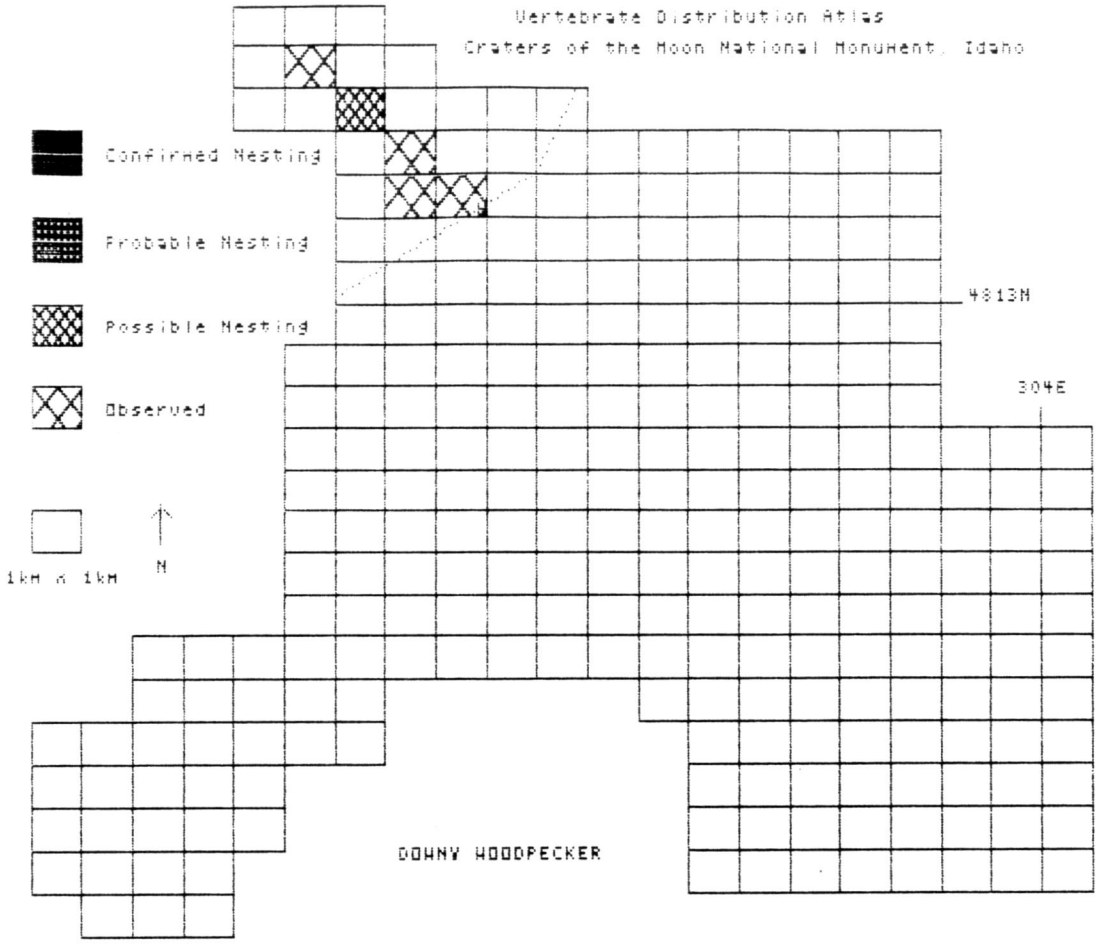

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
BELTED KINGFISHER

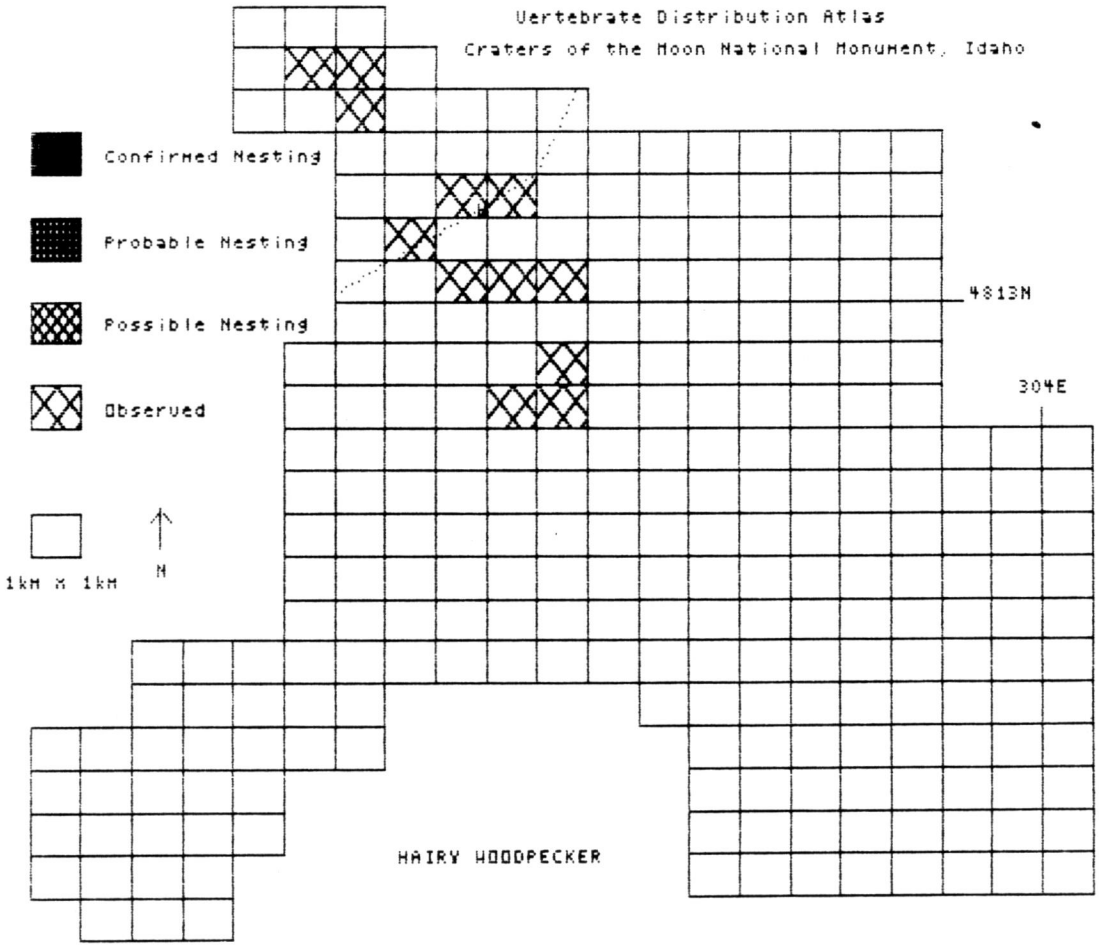

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
LEWIS' WOODPECKER

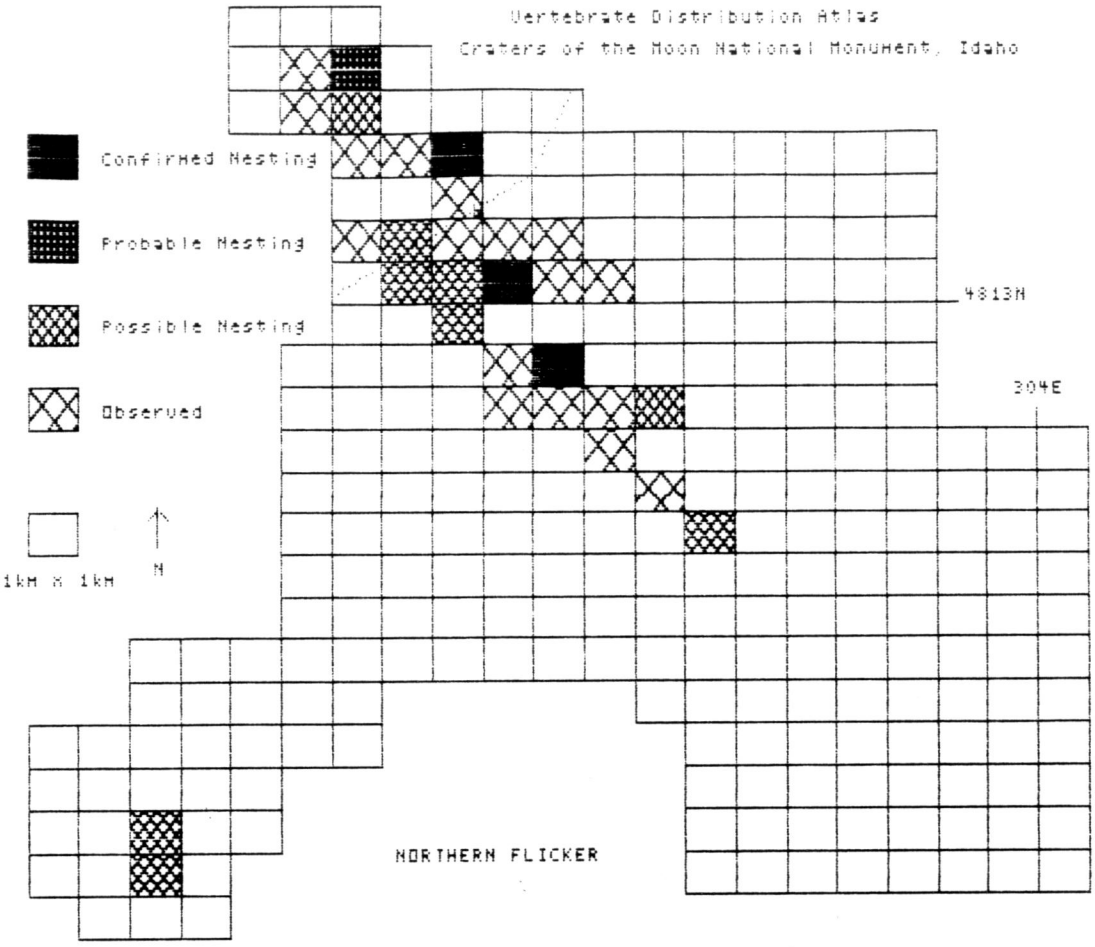

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
RED-HEADED WOODPECKER

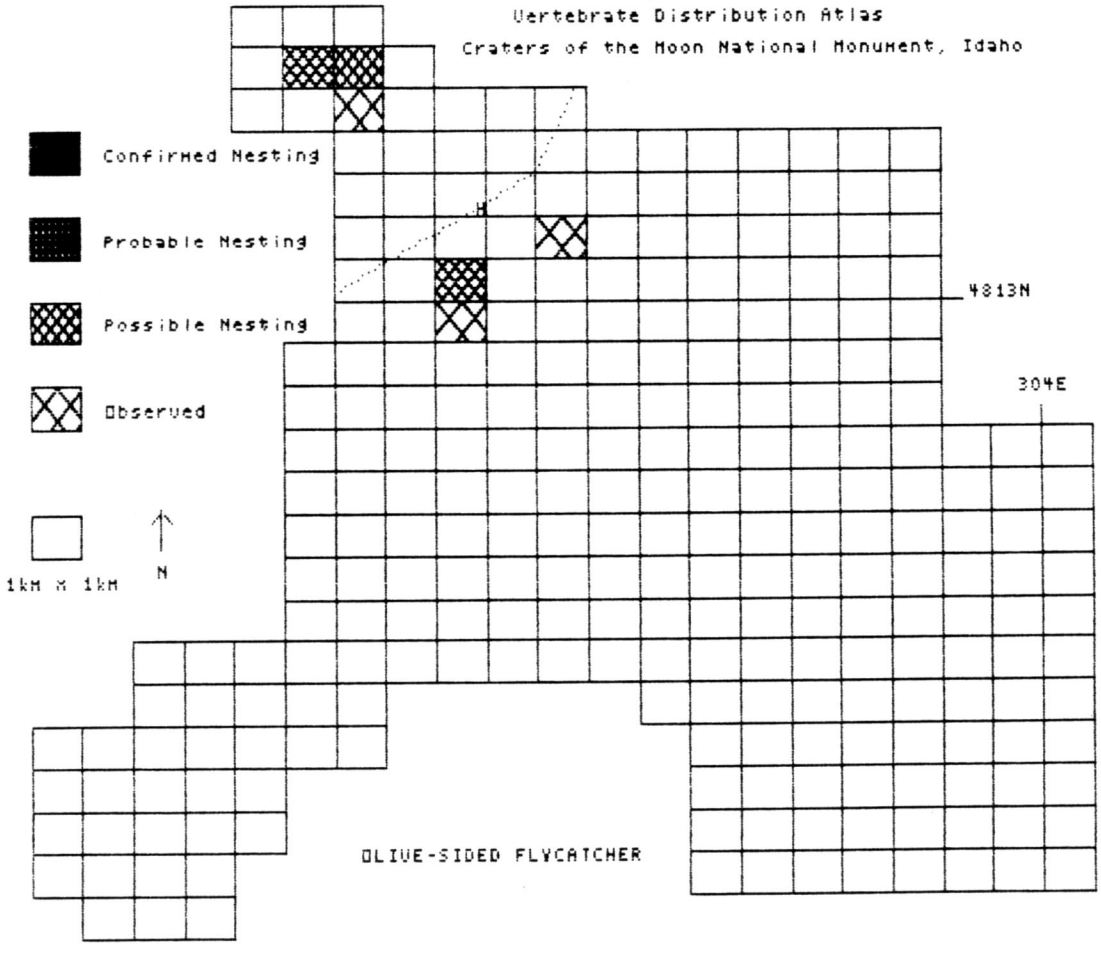

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
RED-NAPED SAPSUCKER

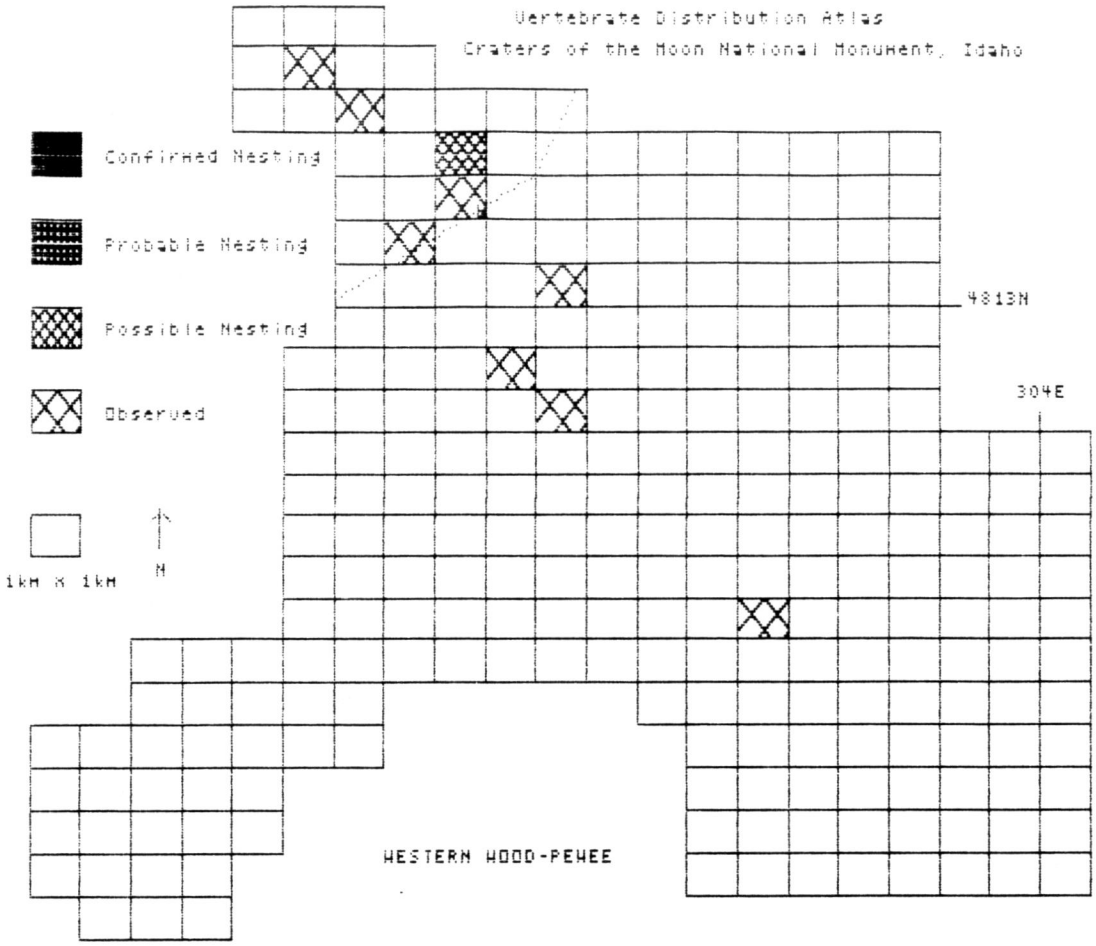

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WILLIAMSON'S SAPSUCKER

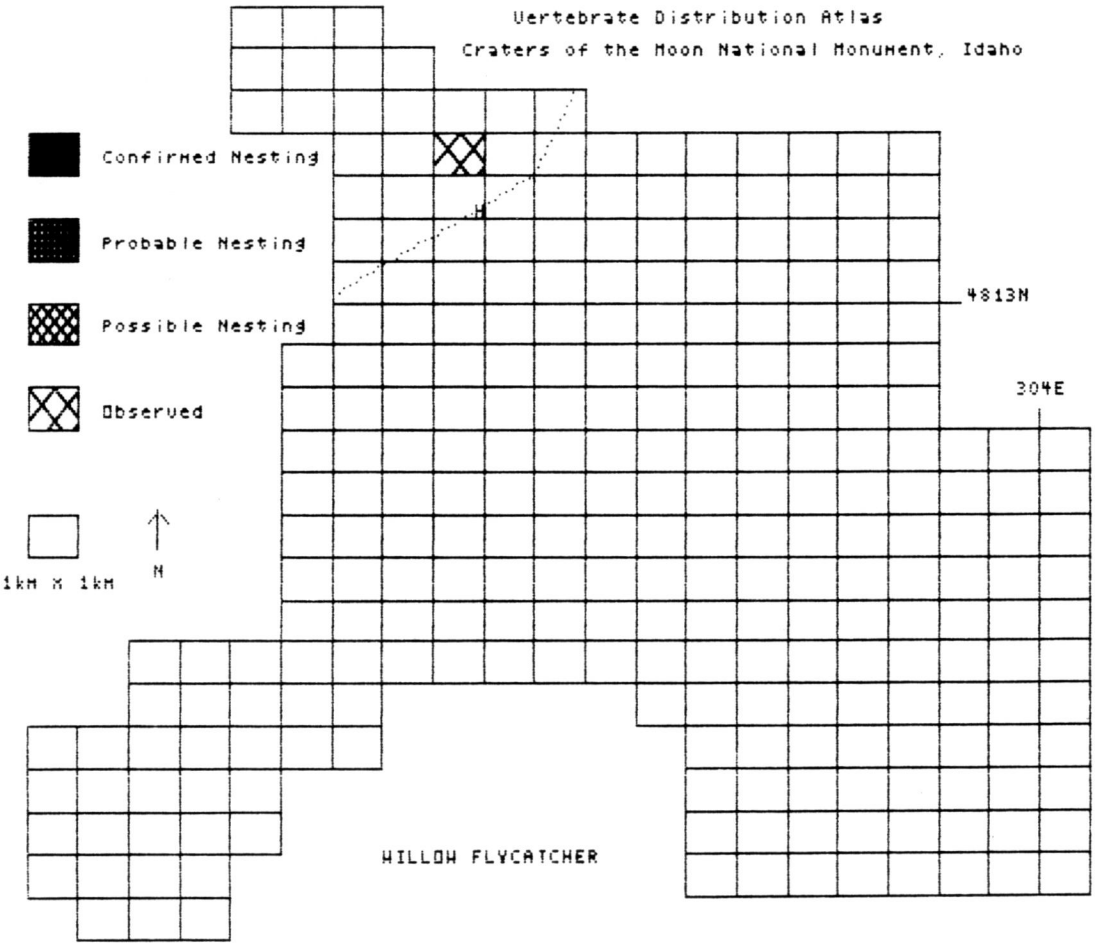

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
DOWNY WOODPECKER

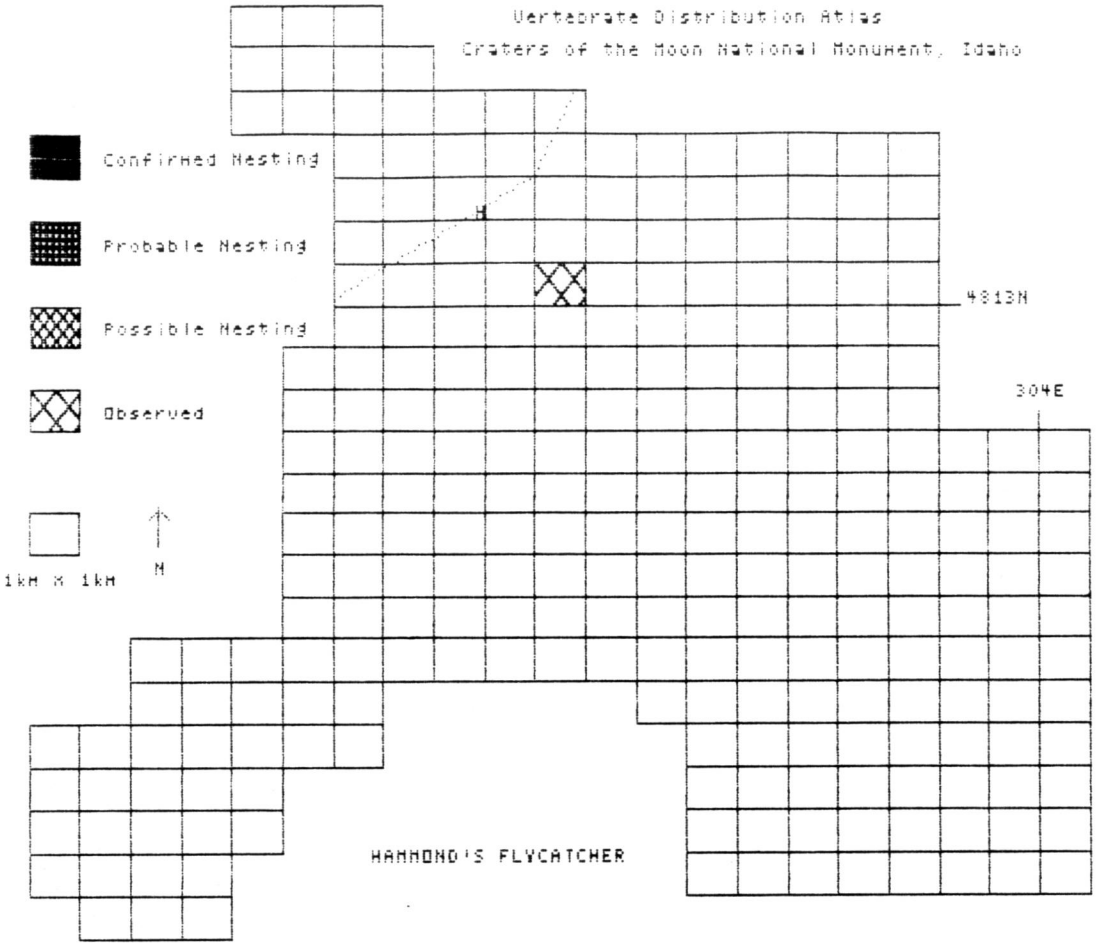

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
HAIRY WOODPECKER

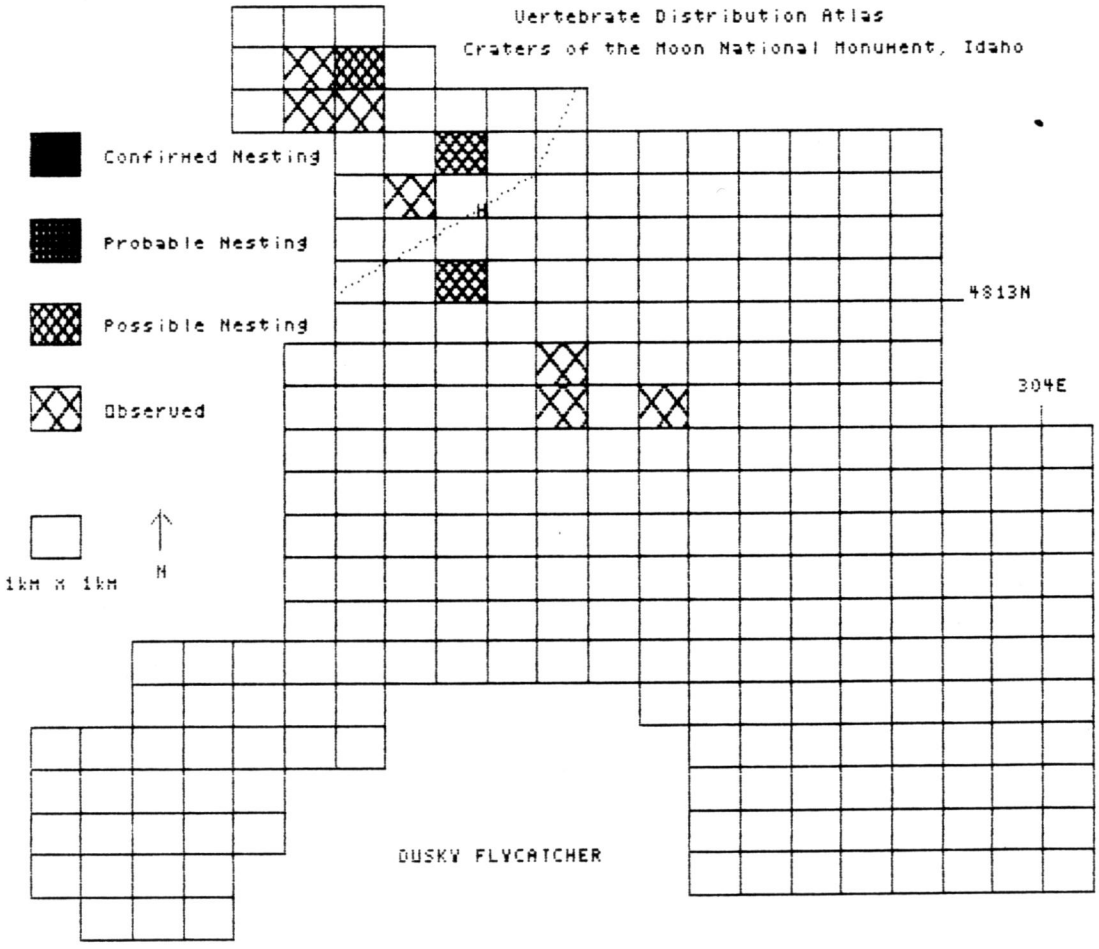

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
NORTHERN FLICKER

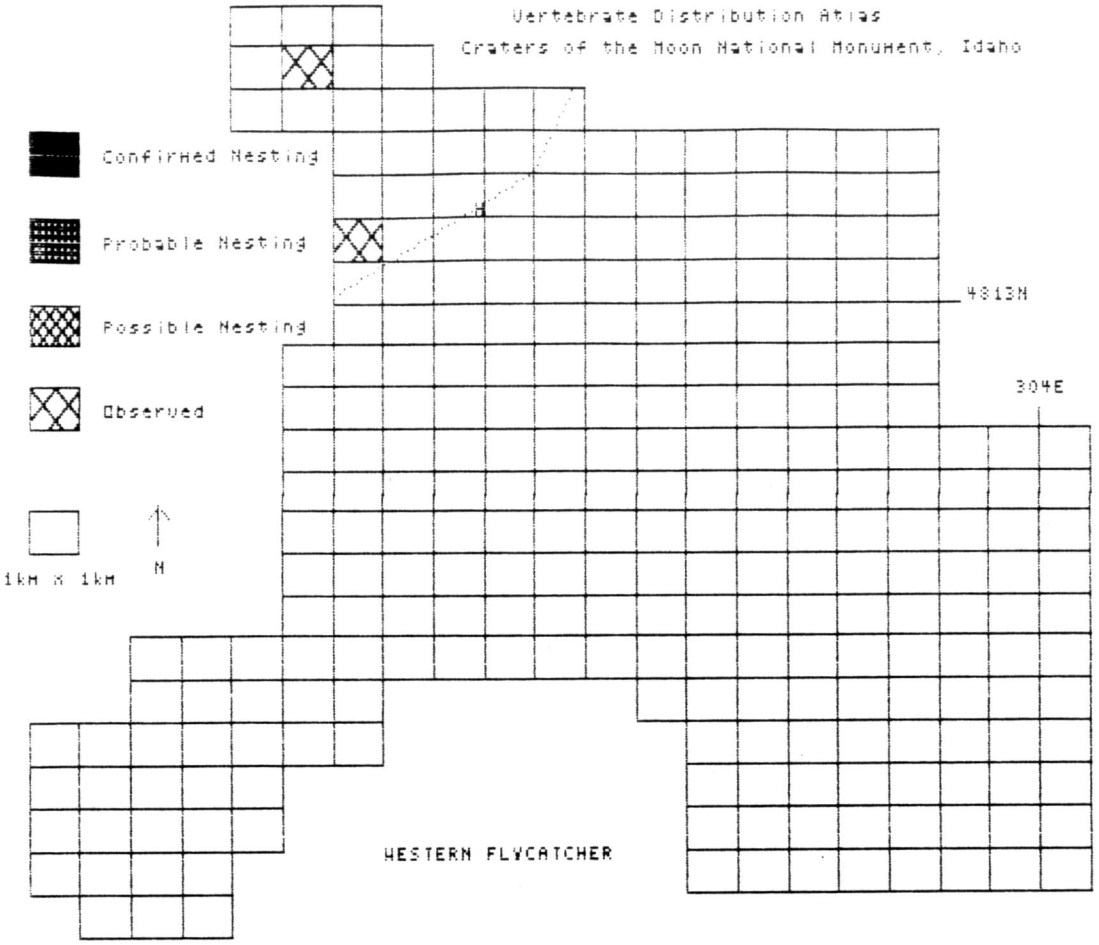

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
OLIVE-SIDED FLYCATCHER

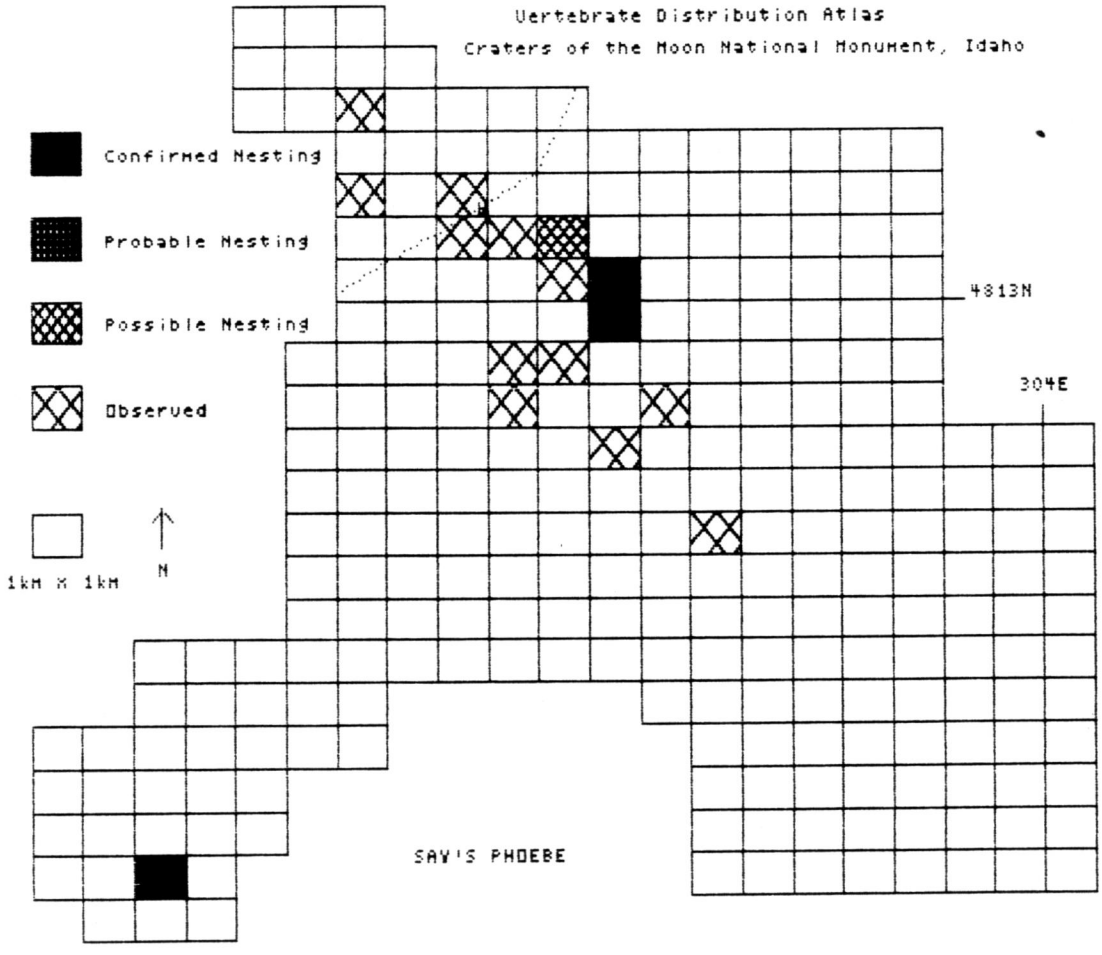

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WESTERN WOOD-PEWEE

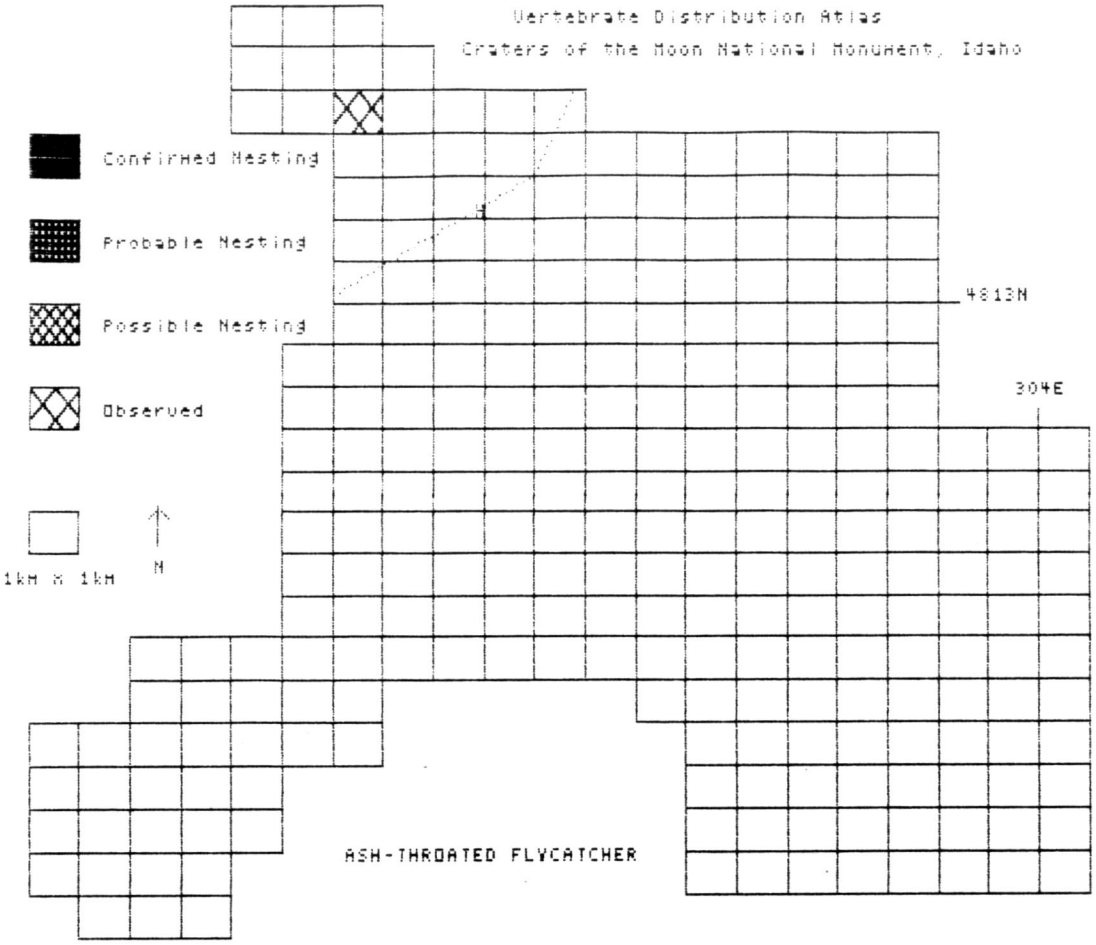

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WILLOW FLYCATCHER

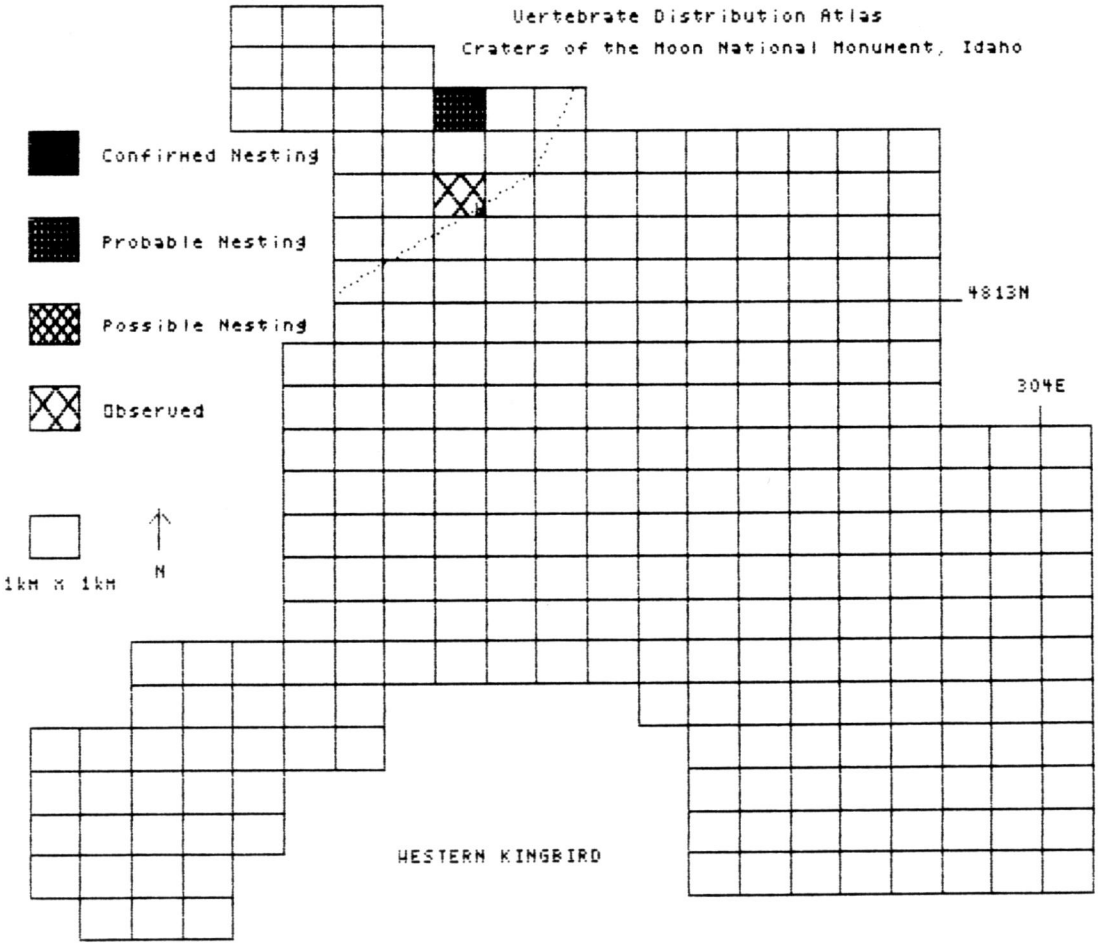

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
HAMMOND'S FLYCATCHER

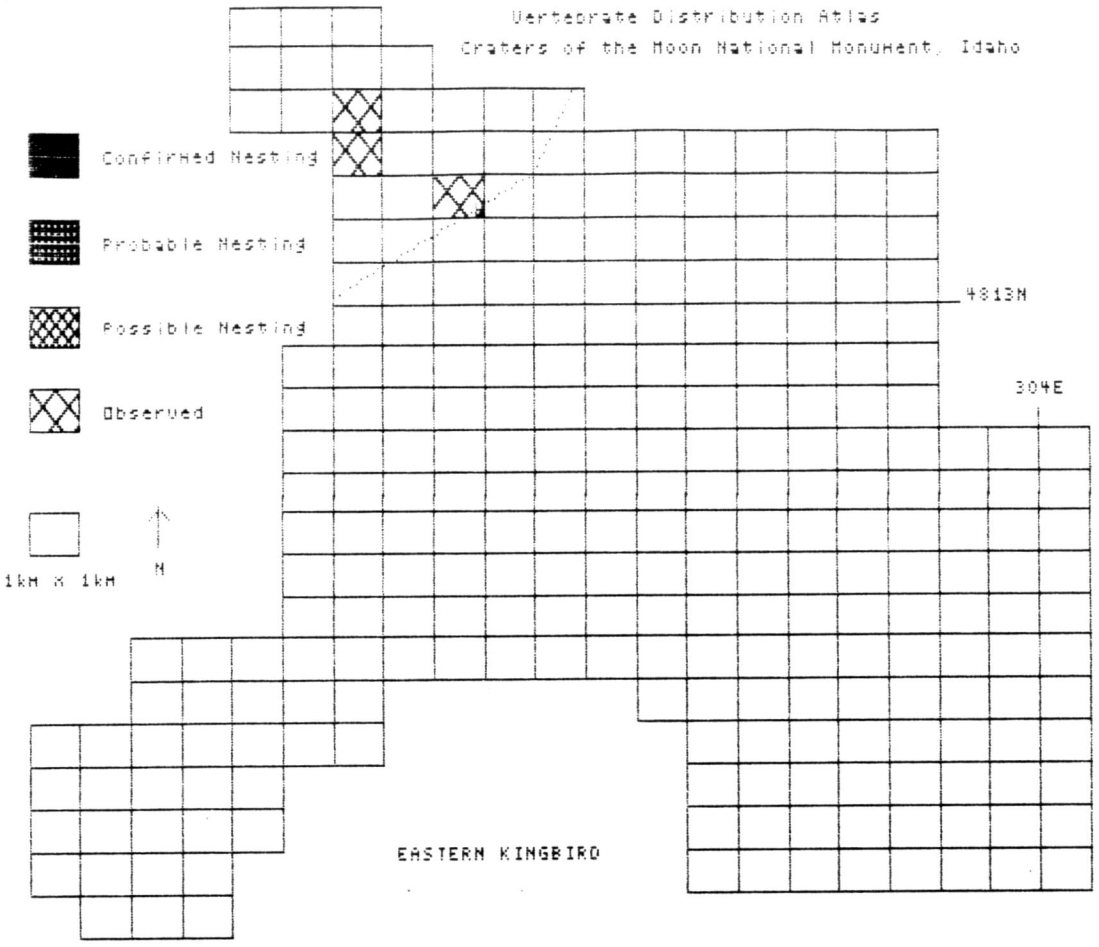

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
DUSKY FLYCATCHER

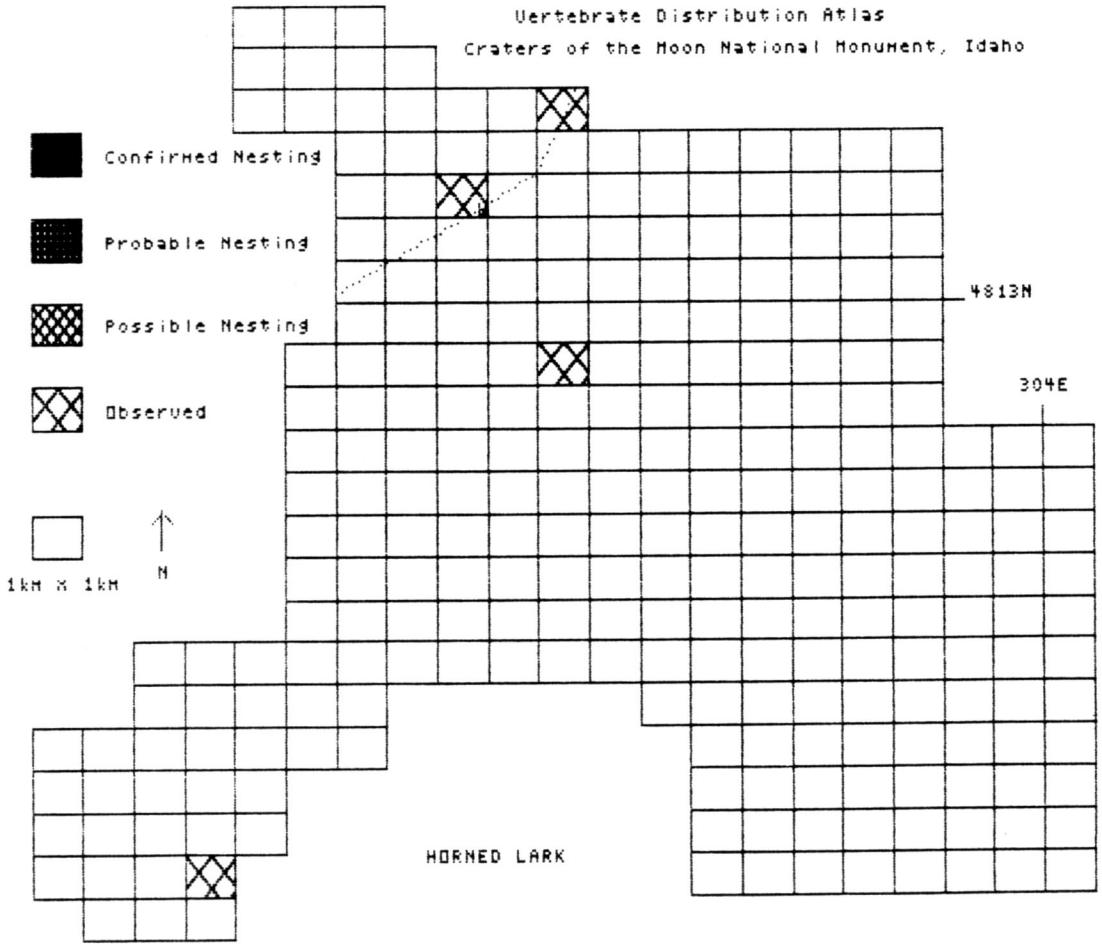

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WESTERN FLYCATCHER

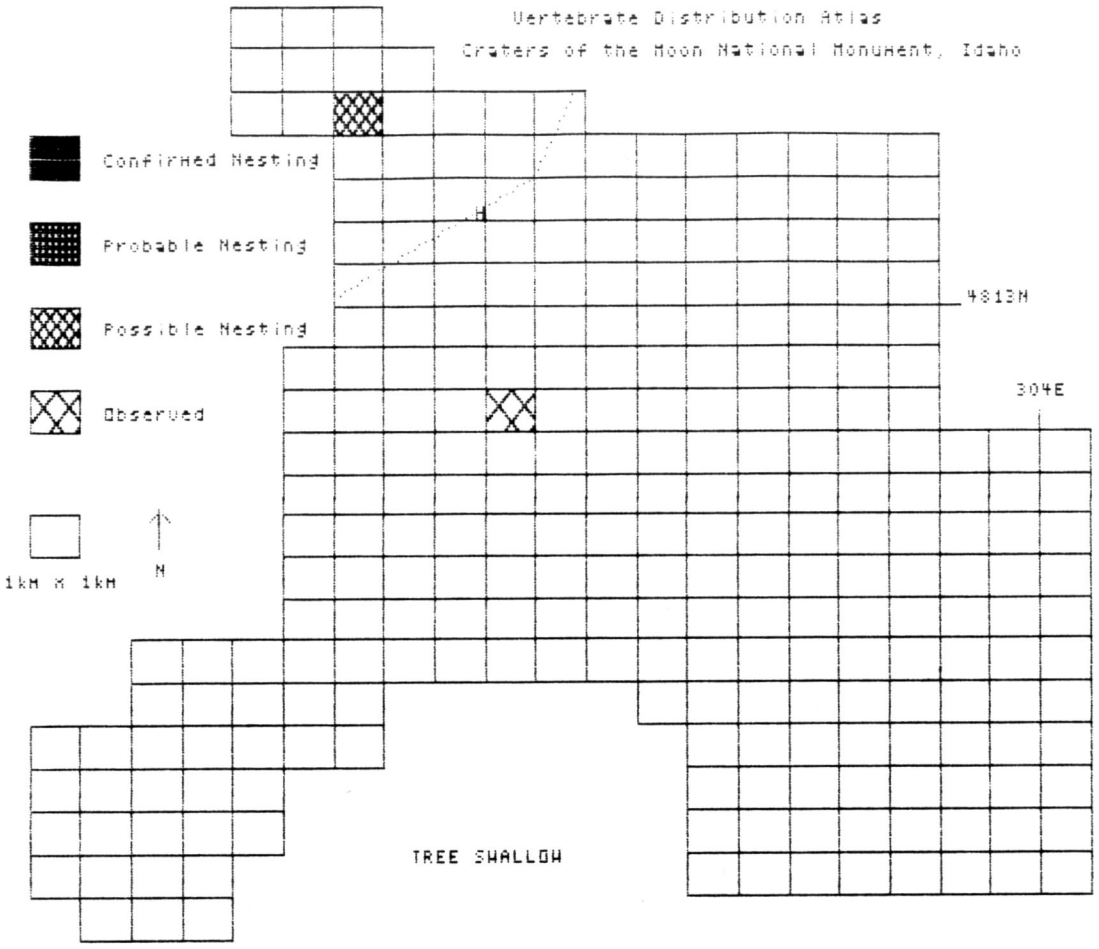

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
SAY'S PHOEBE

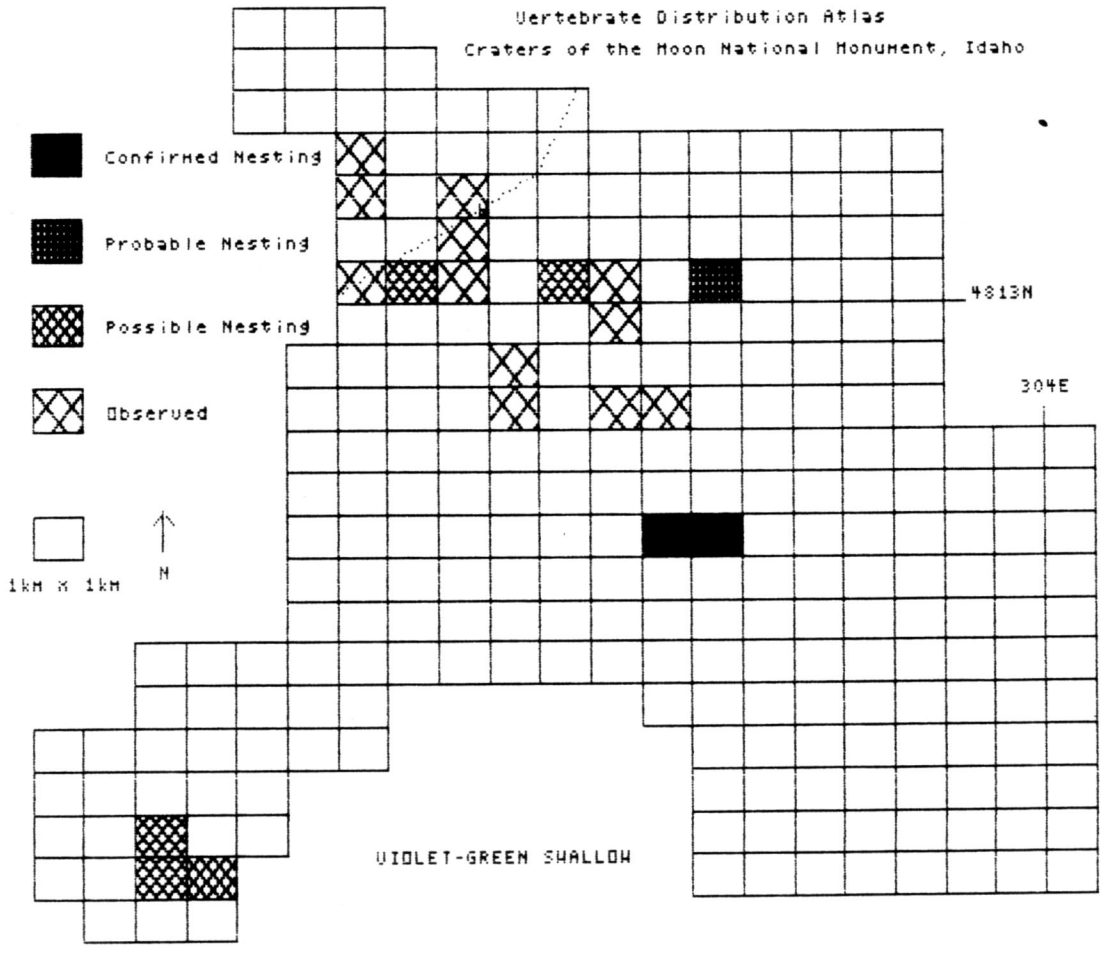

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
ASH-THROATED FLYCATCHER

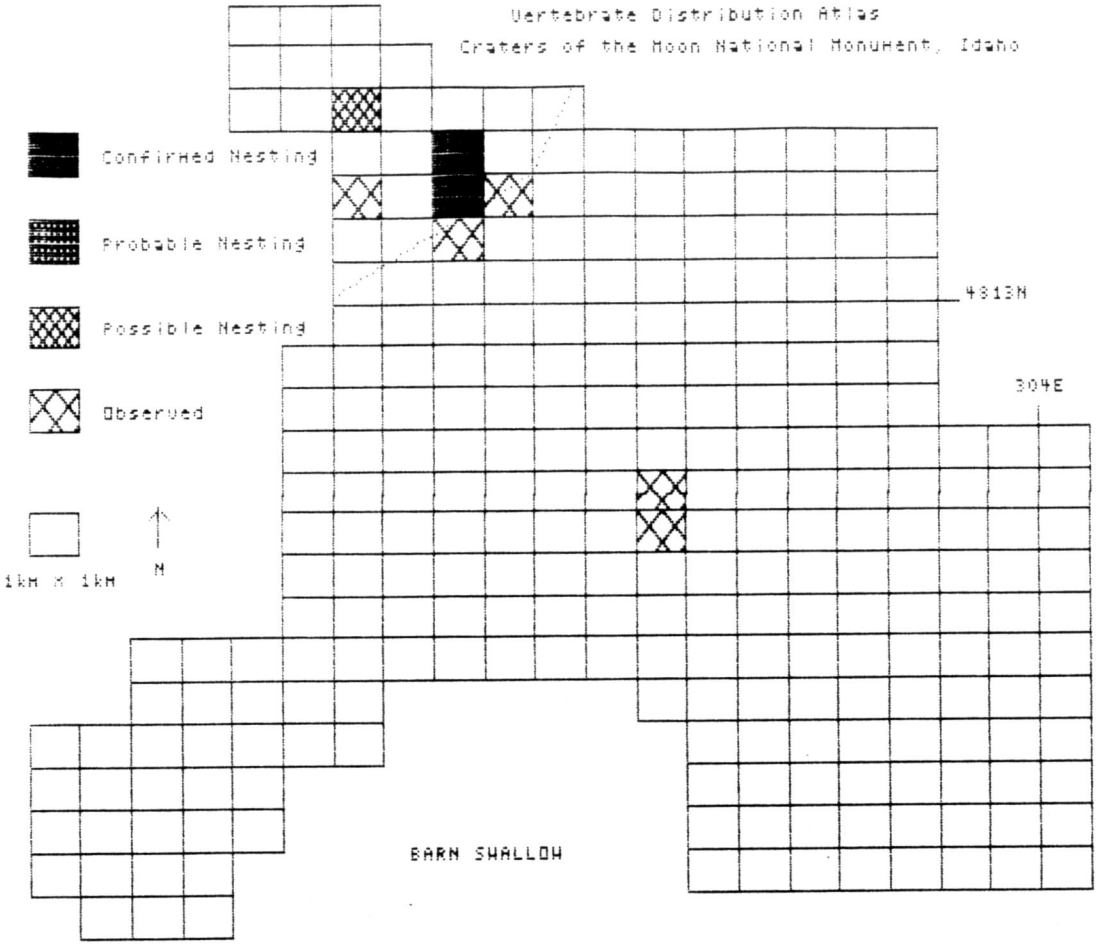

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WESTERN KINGBIRD

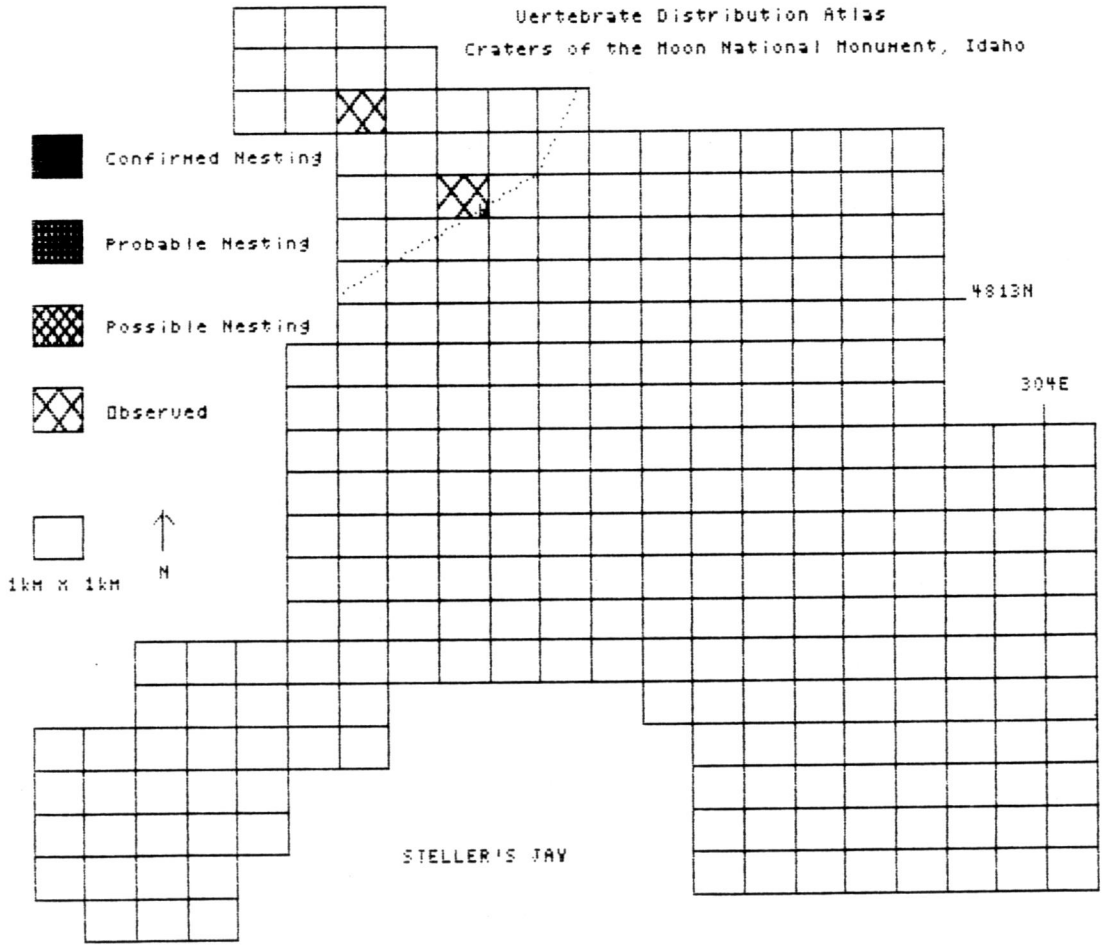

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
EASTERN KINGBIRD

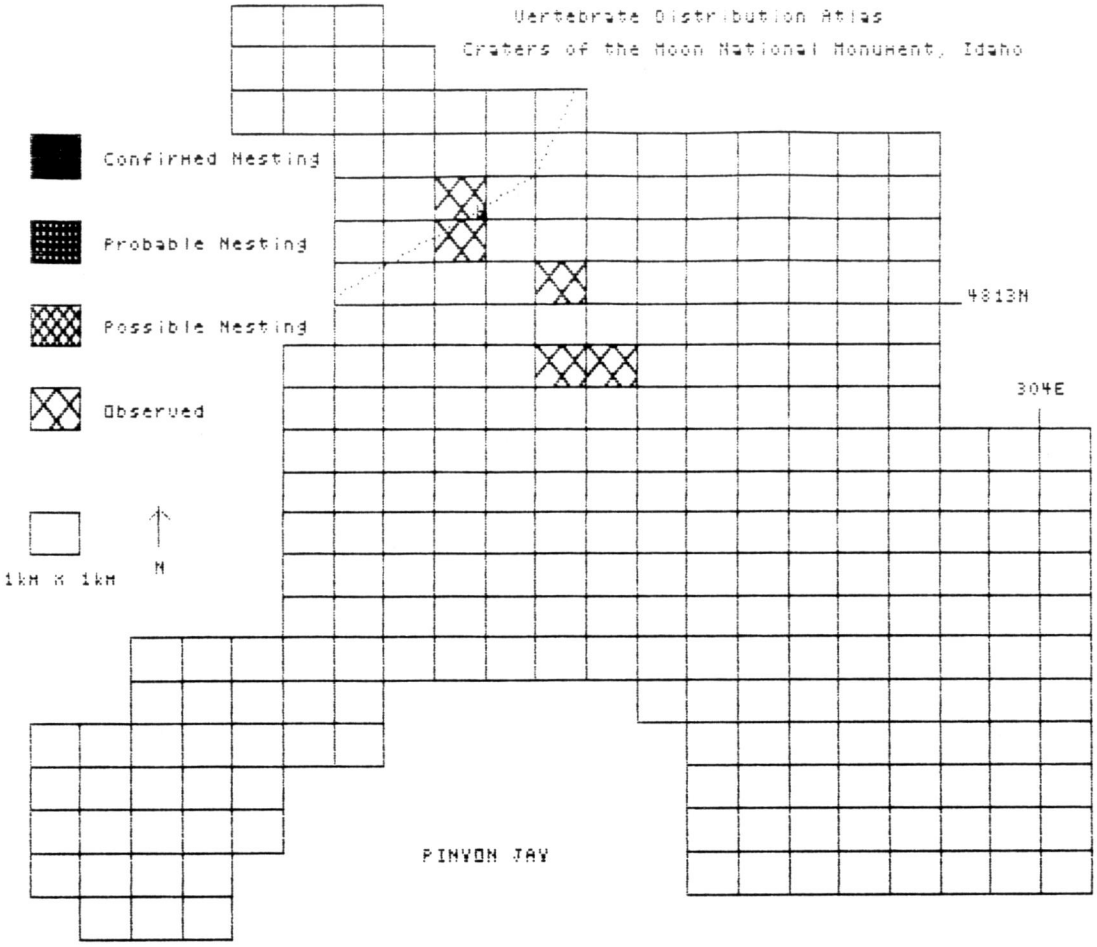

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
HORNED LARK

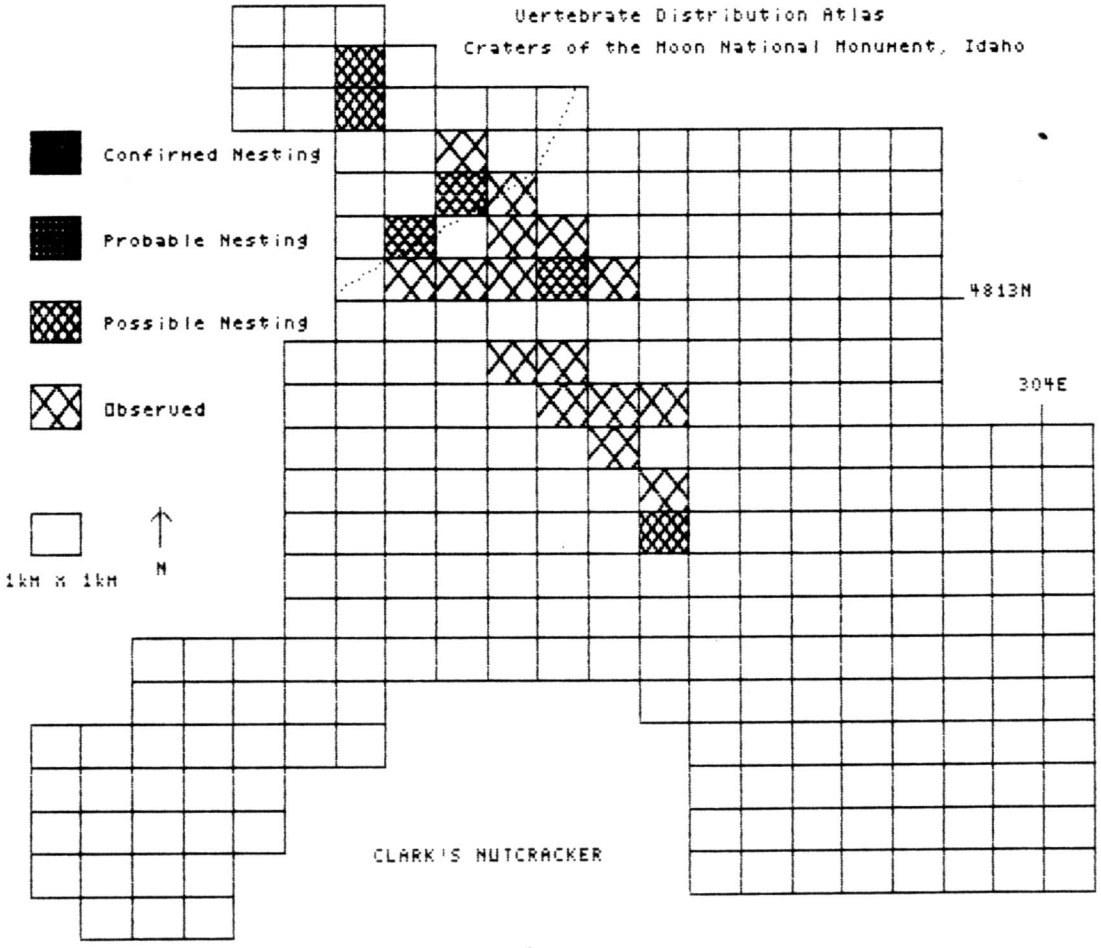

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
TREE SWALLOW

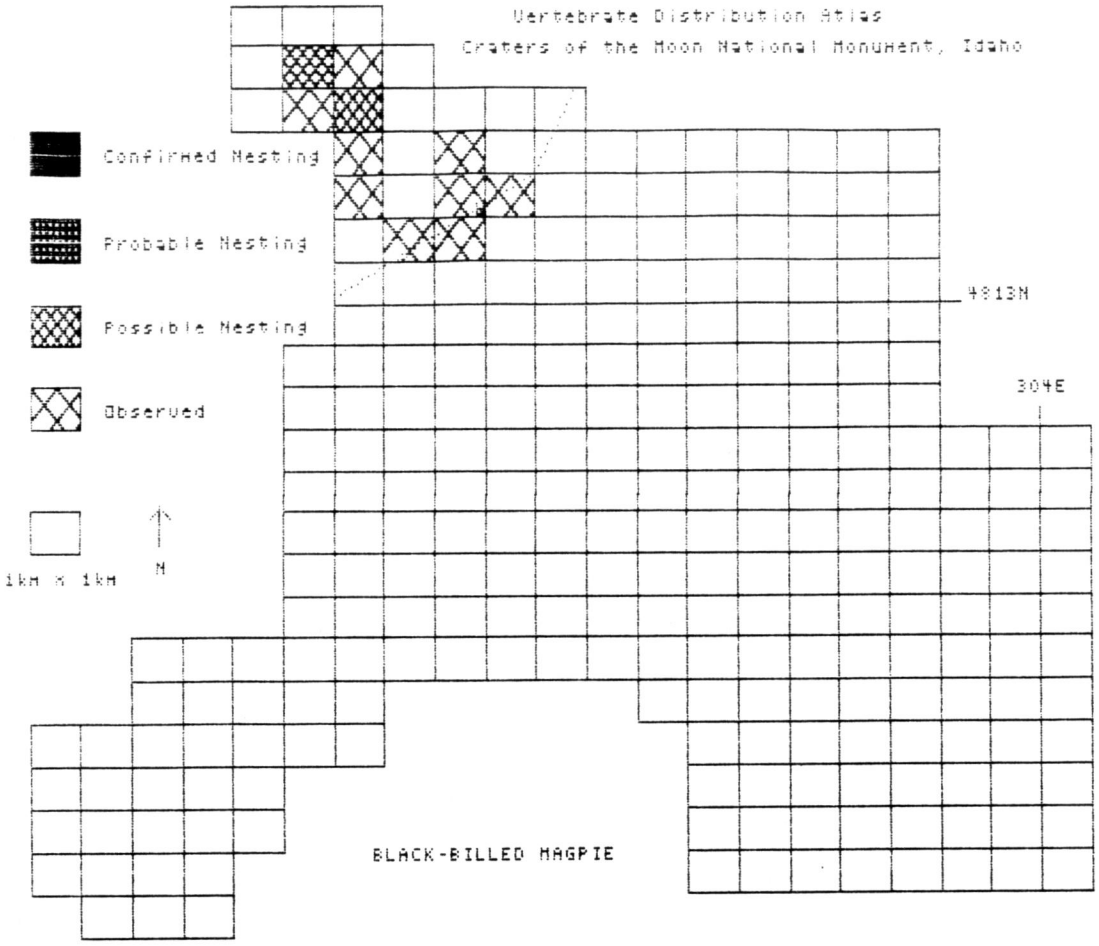

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
VIOLET-GREEN SWALLOW

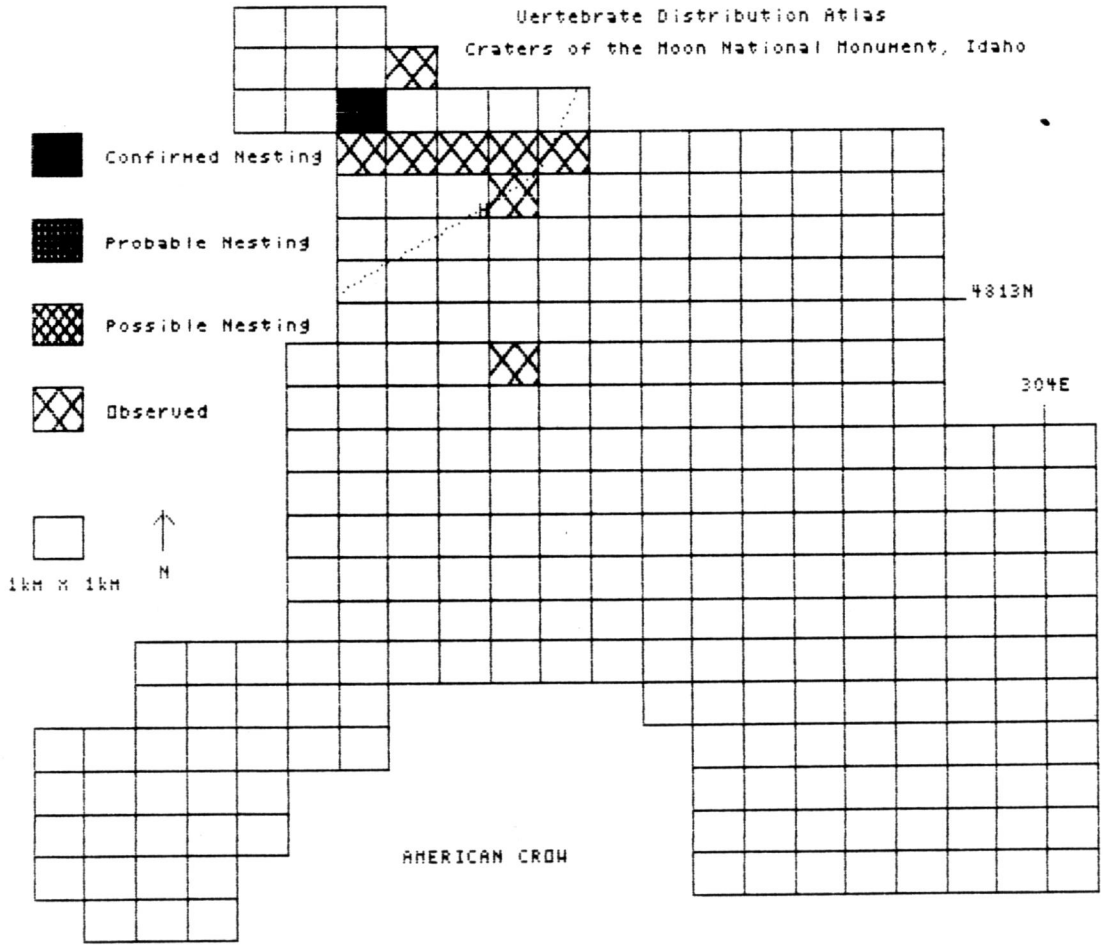

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
BARN SWALLOW

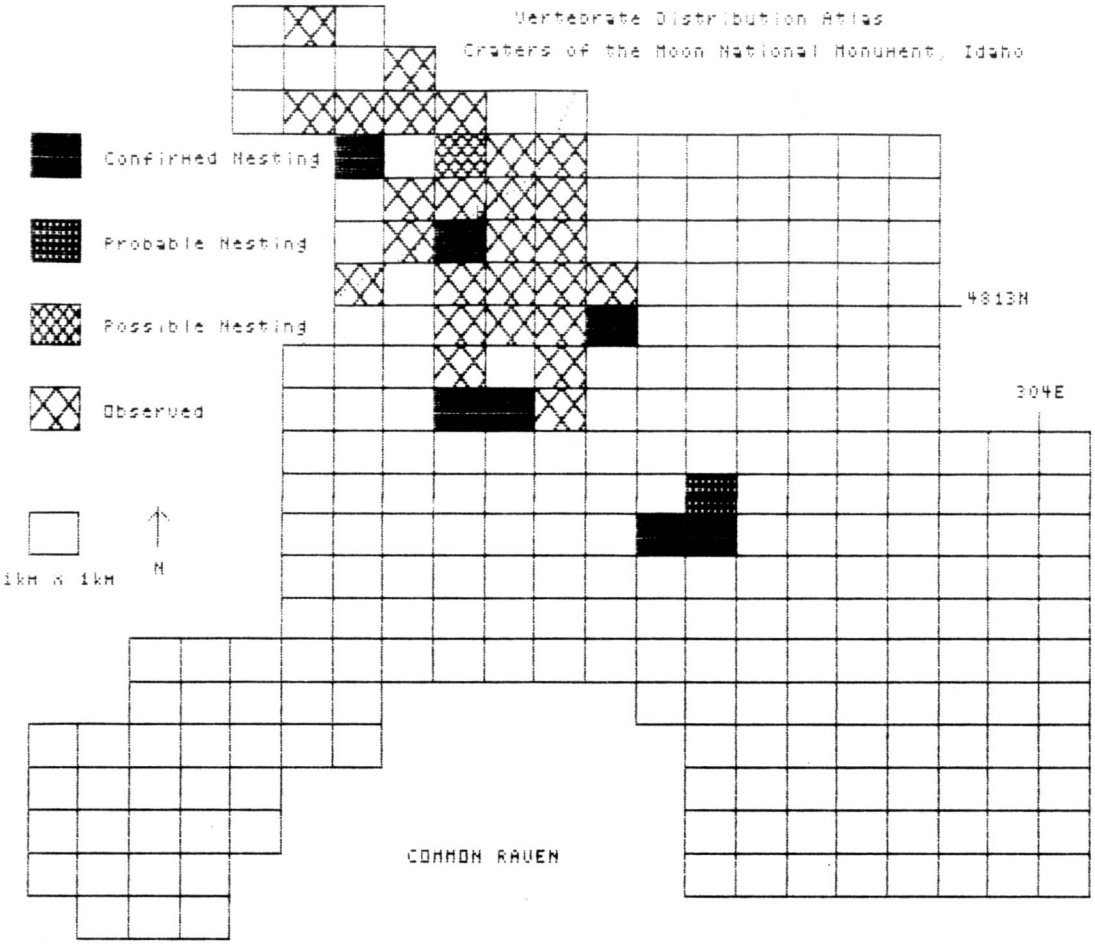

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
STELLER'S JAY

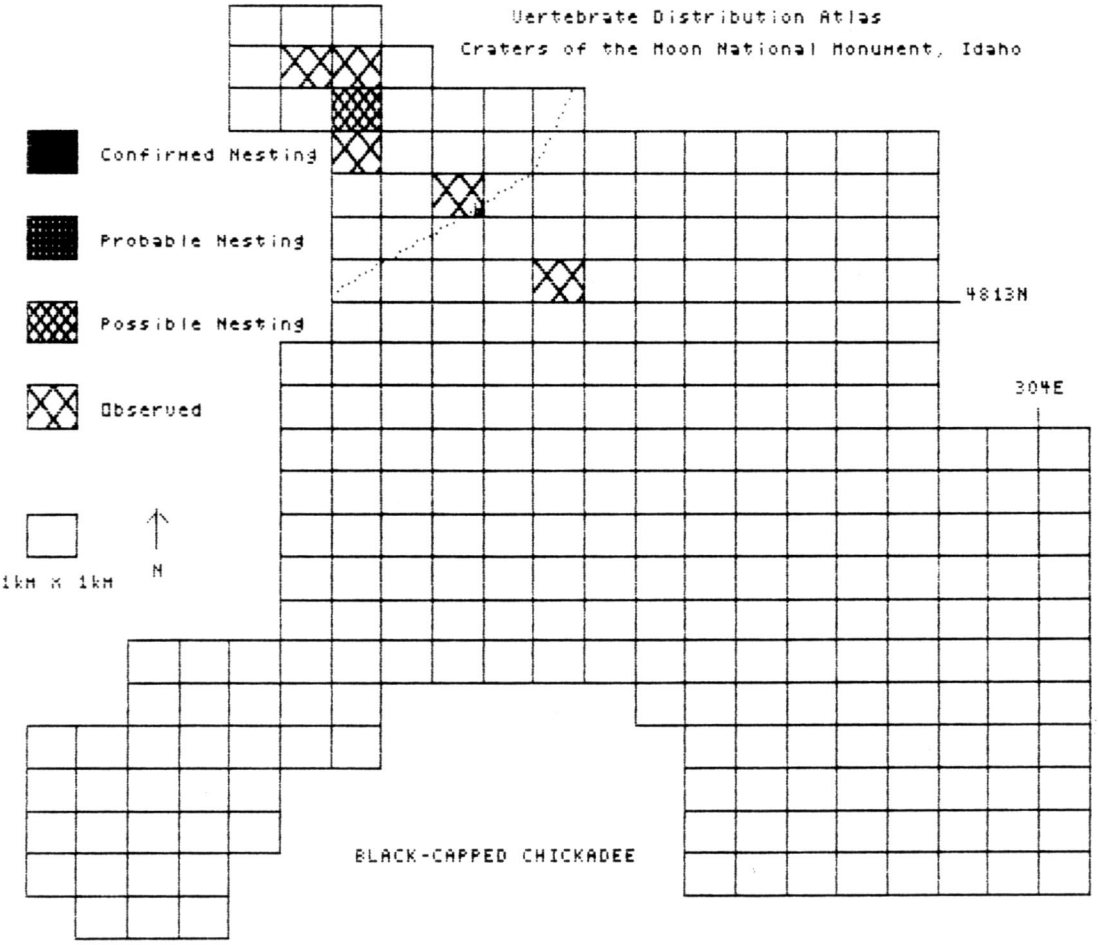

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
PINYON JAY

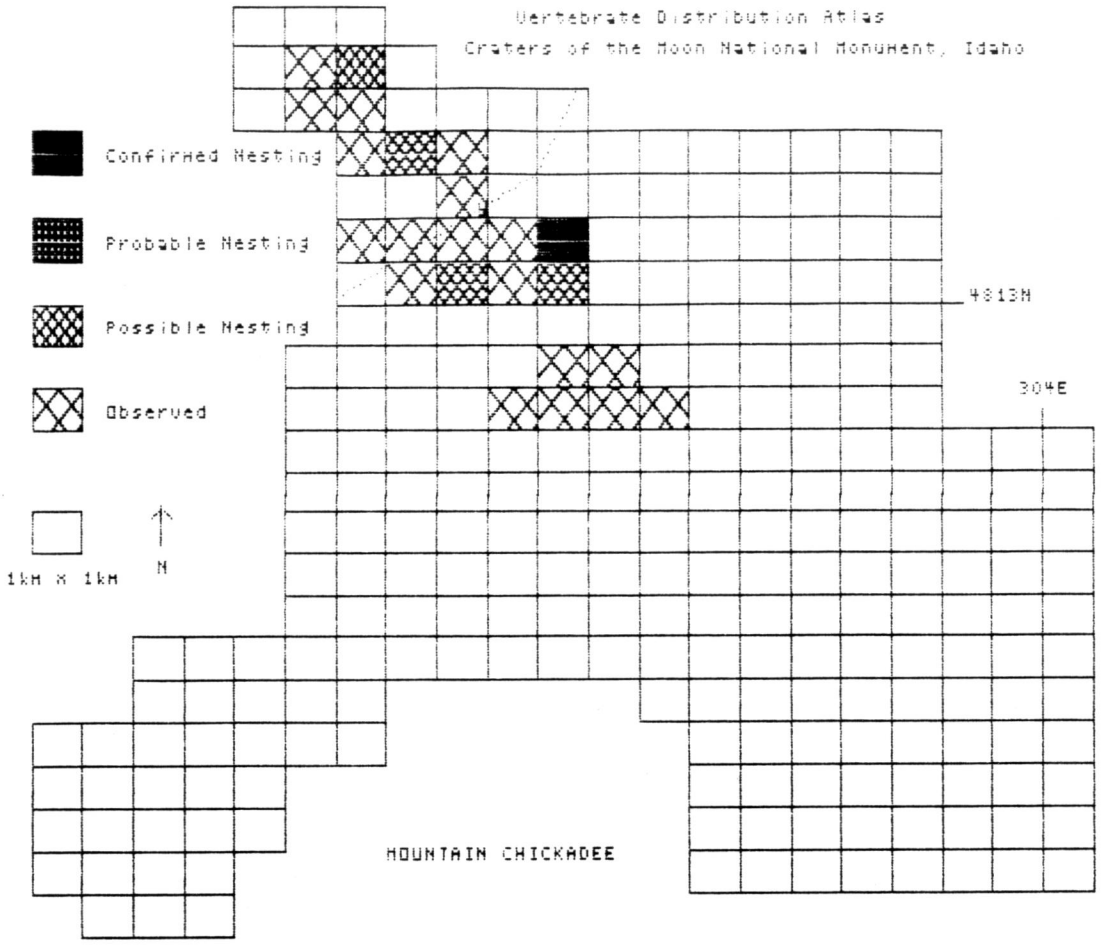

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
CLARK'S NUTCRACKER

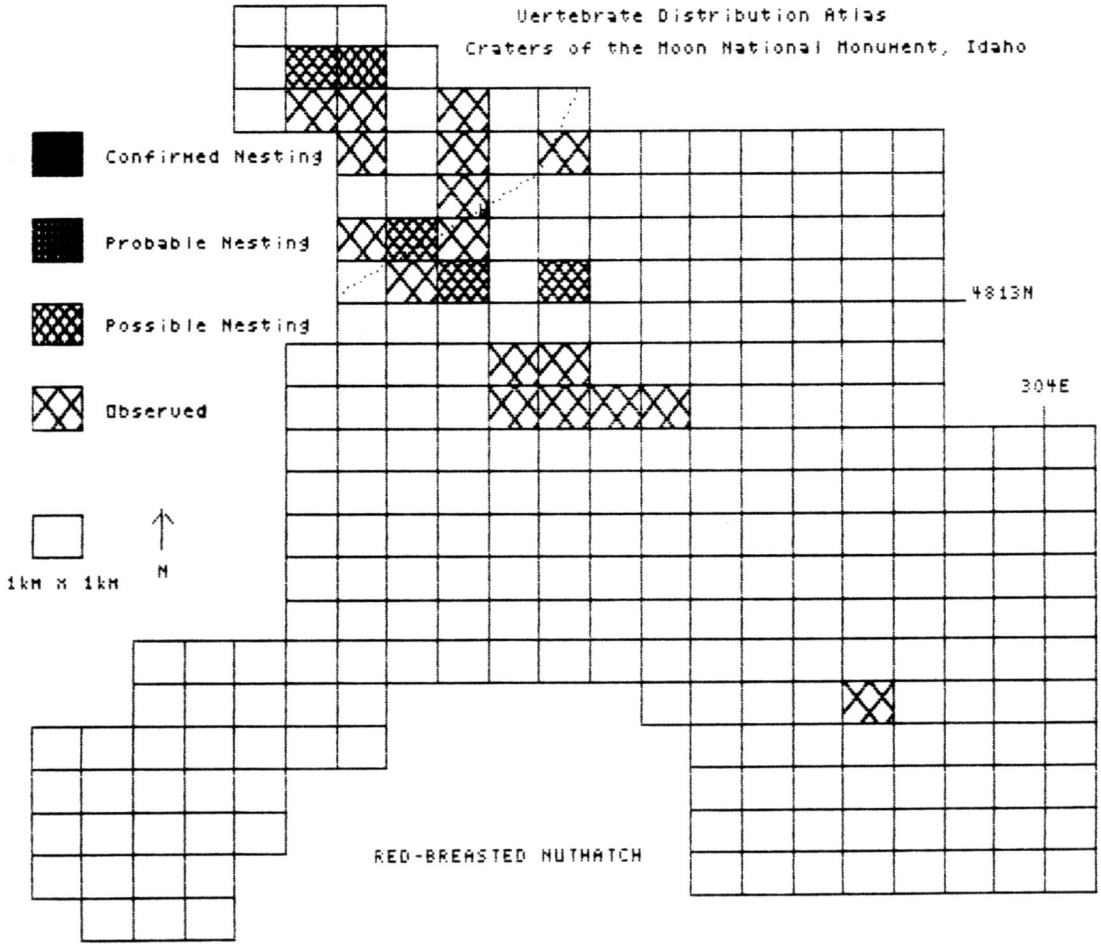

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
BLACK-BILLED MAGPIE

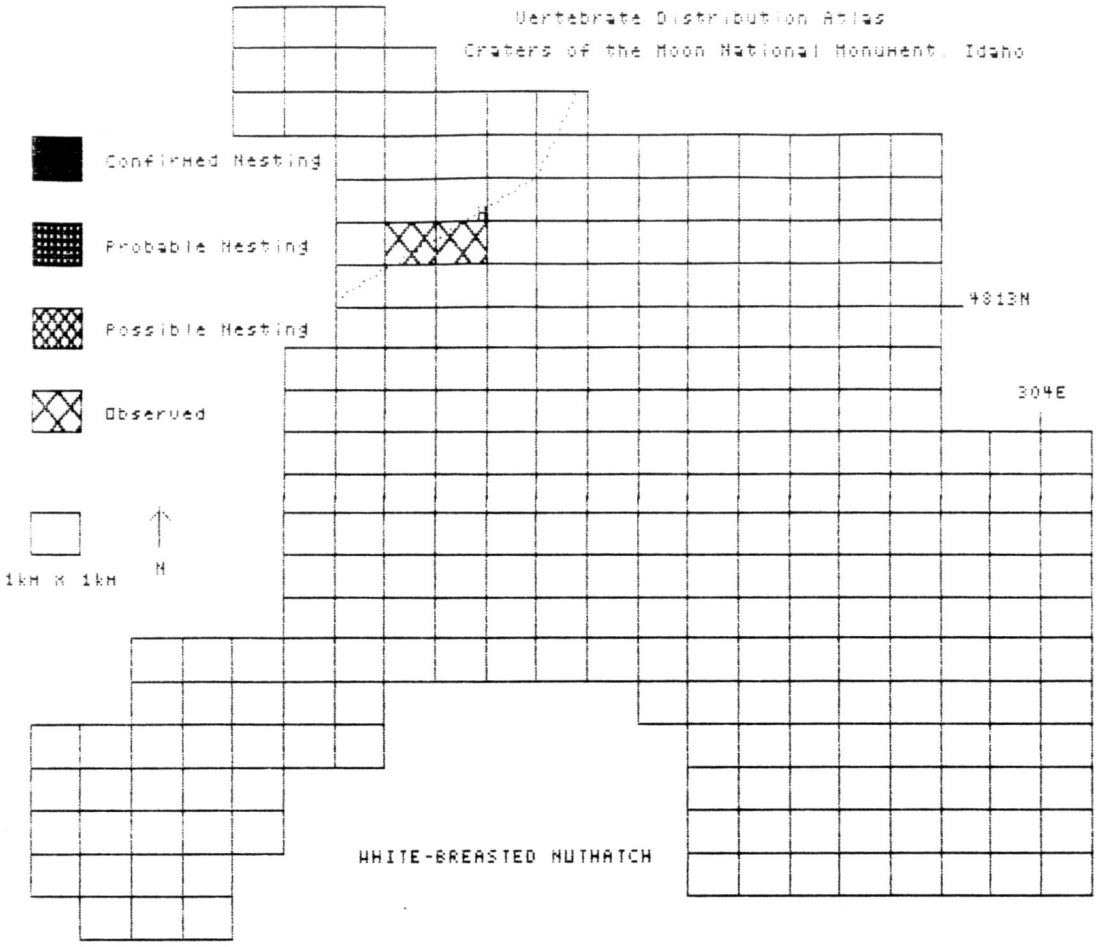

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
AMERICAN CROW

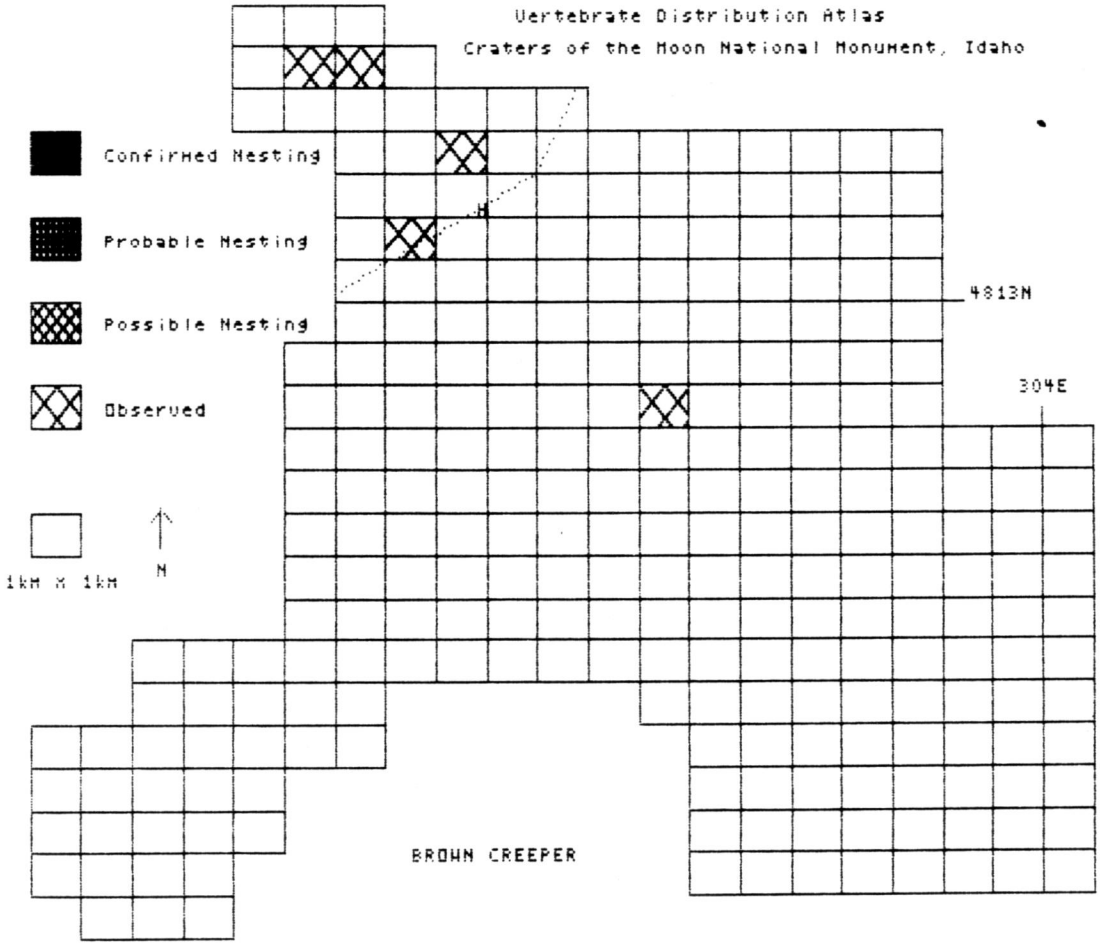

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
COMMON RAVEN

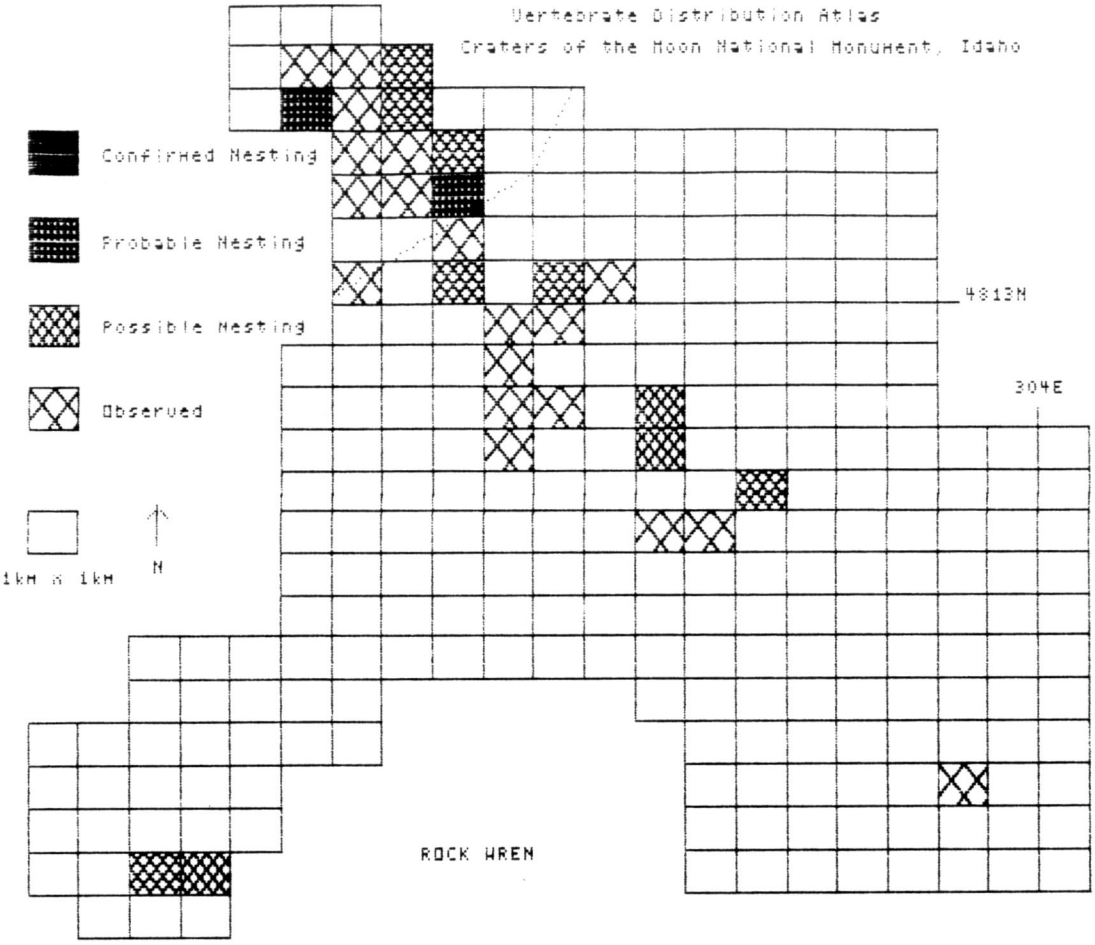

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
BLACK-CAPPED CHICKADEE

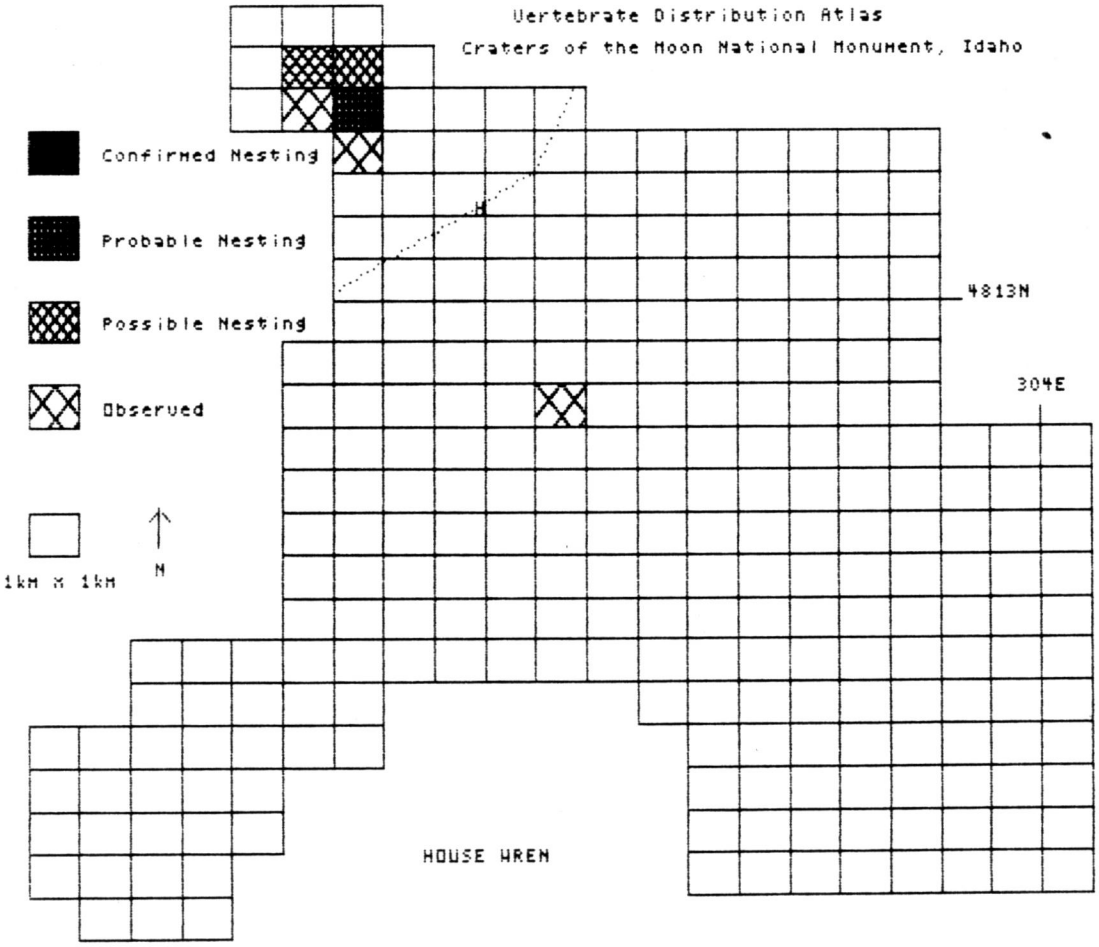

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
MOUNTAIN CHICKADEE

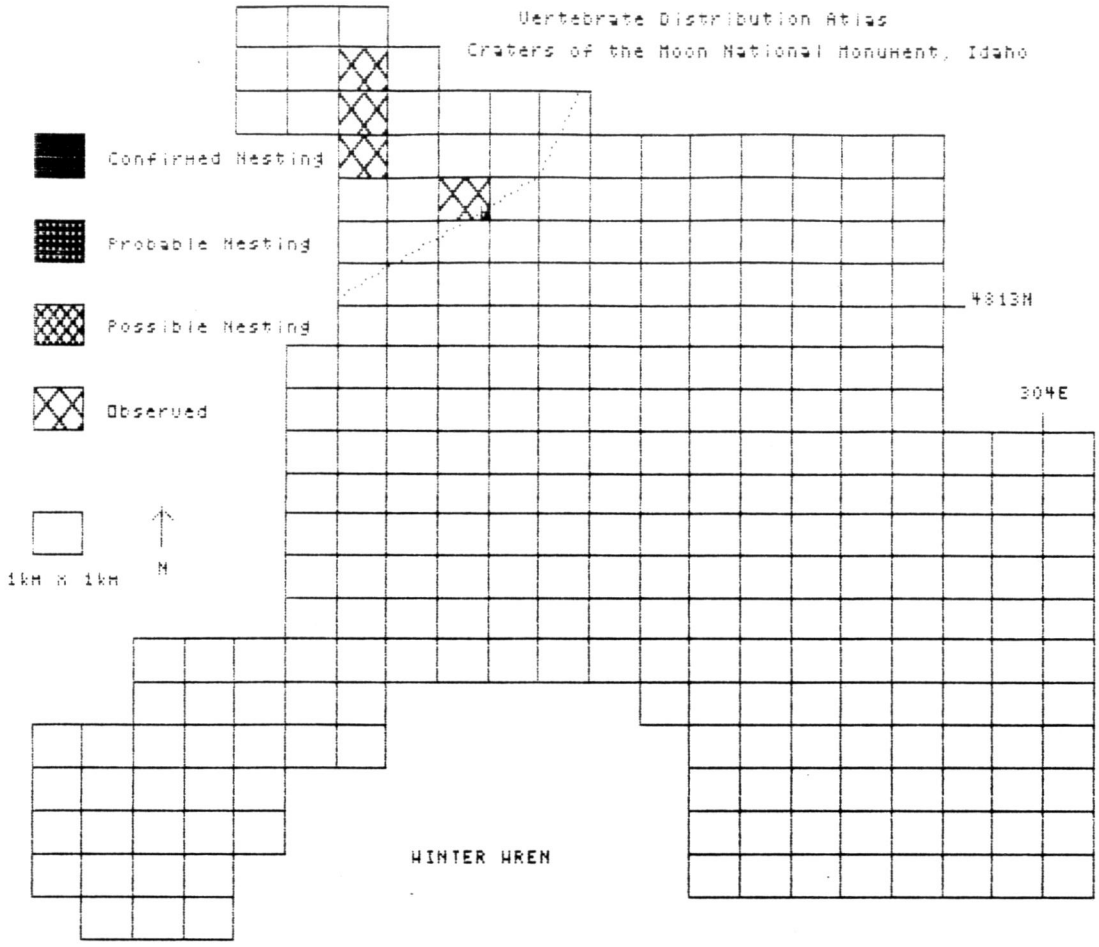

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
RED-BREASTED NUTHATCH

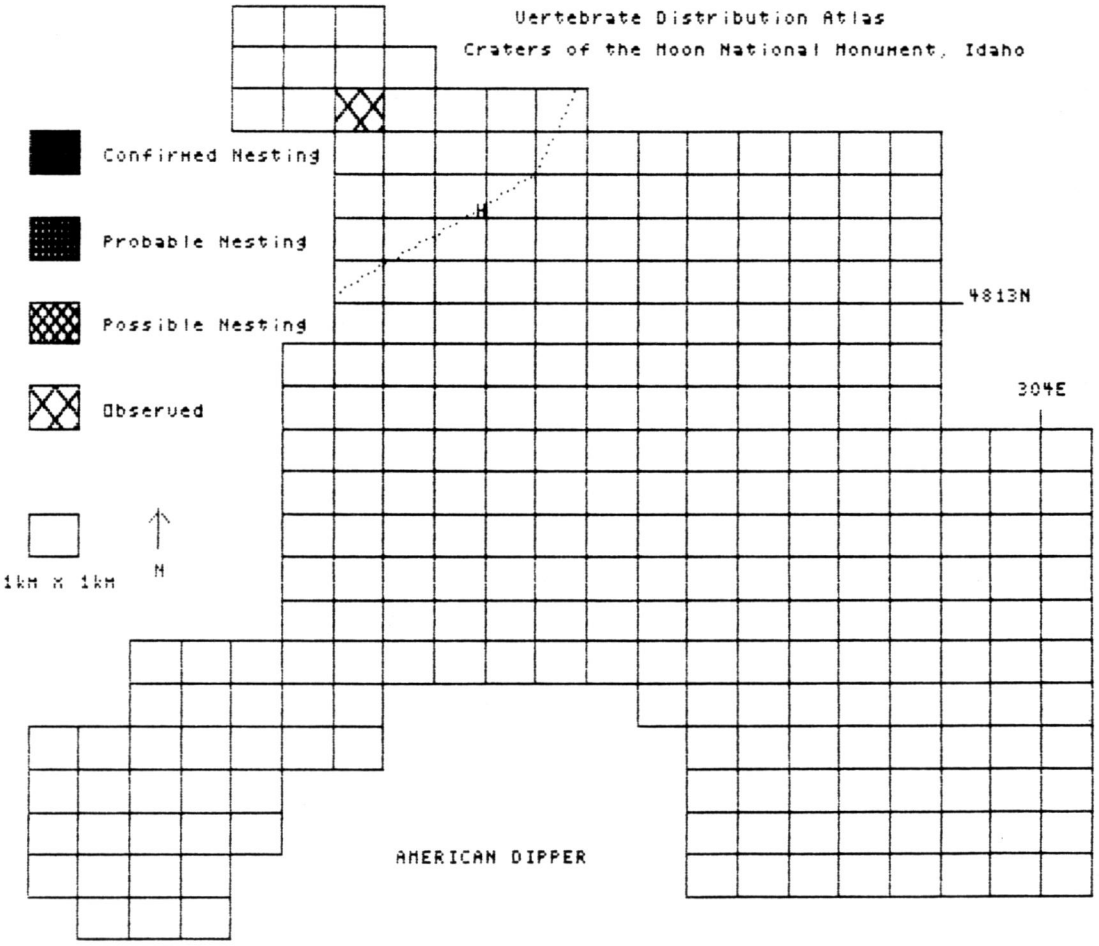

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
WHITE-BREASTED NUTHATCH

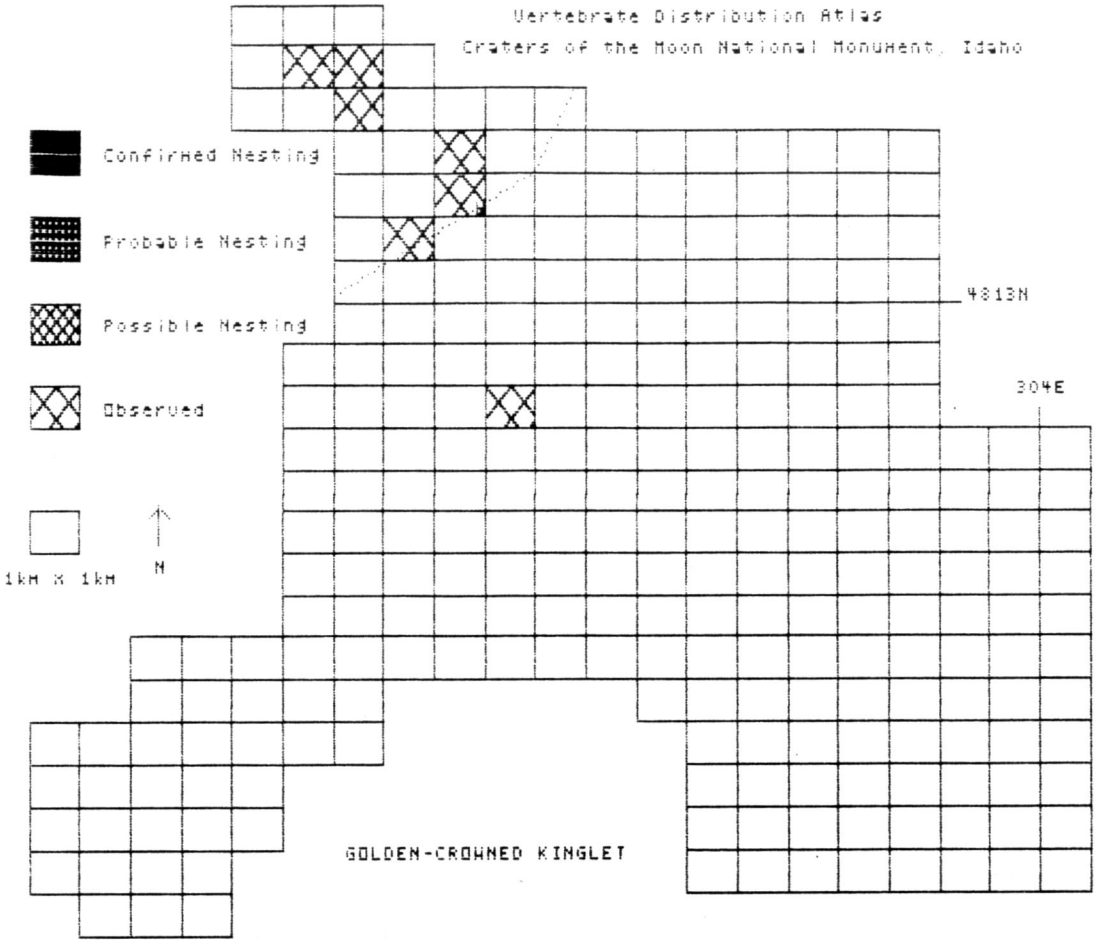

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
BROWN CREEPER

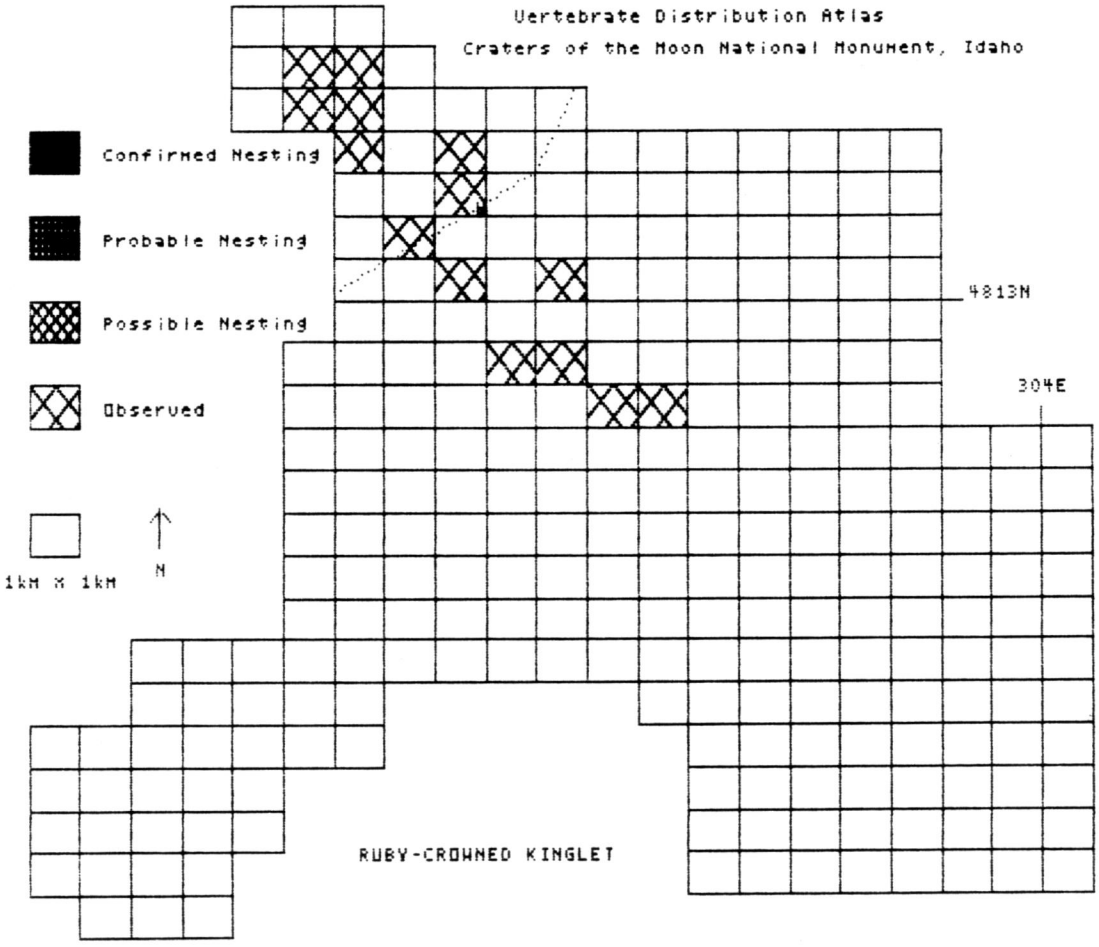

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
ROCK WREN

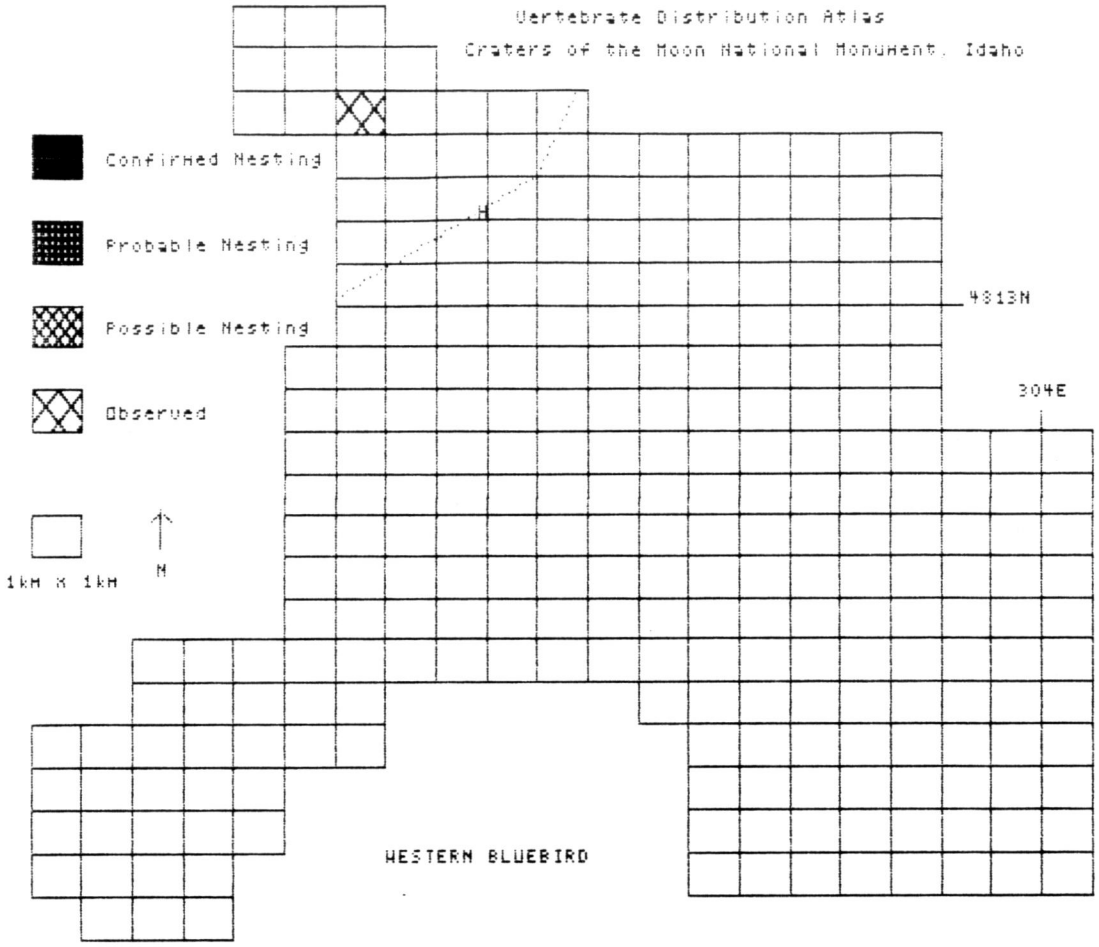

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
HOUSE WREN

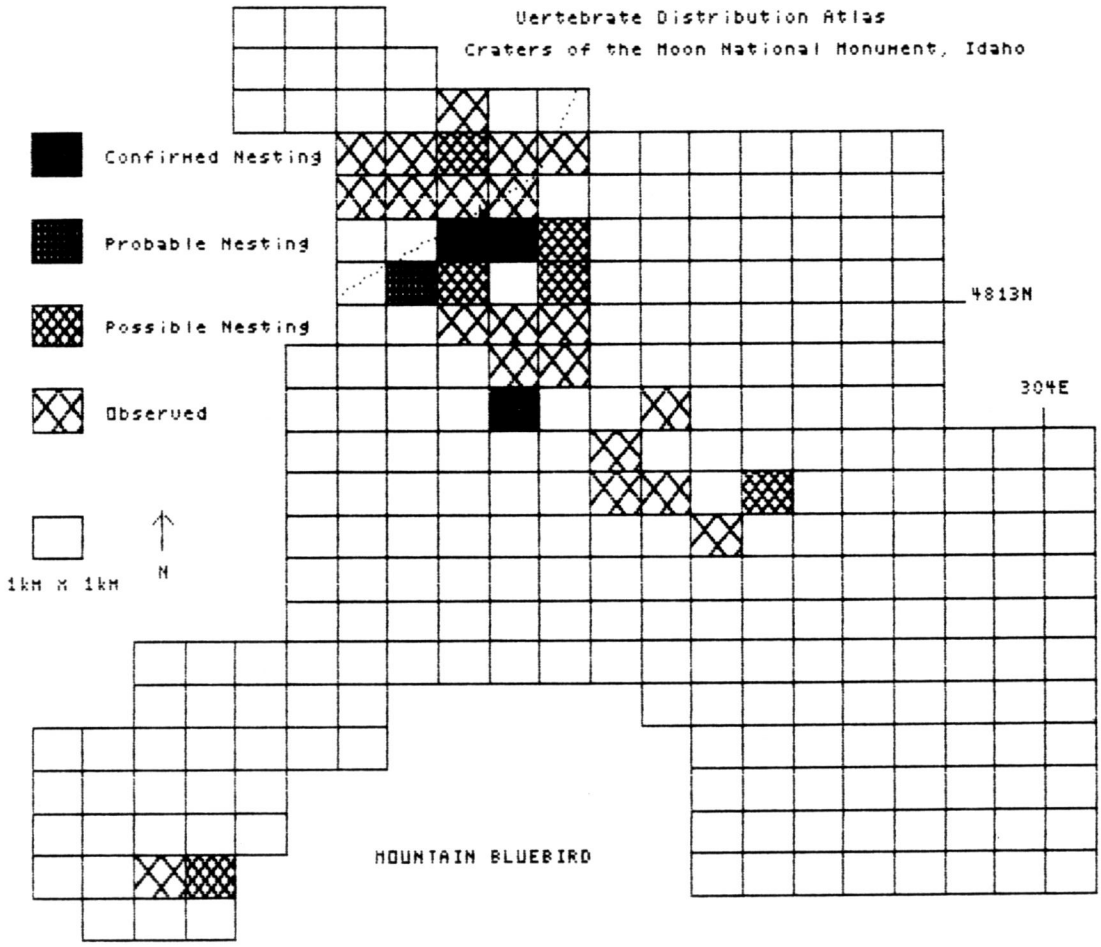

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WINTER WREN

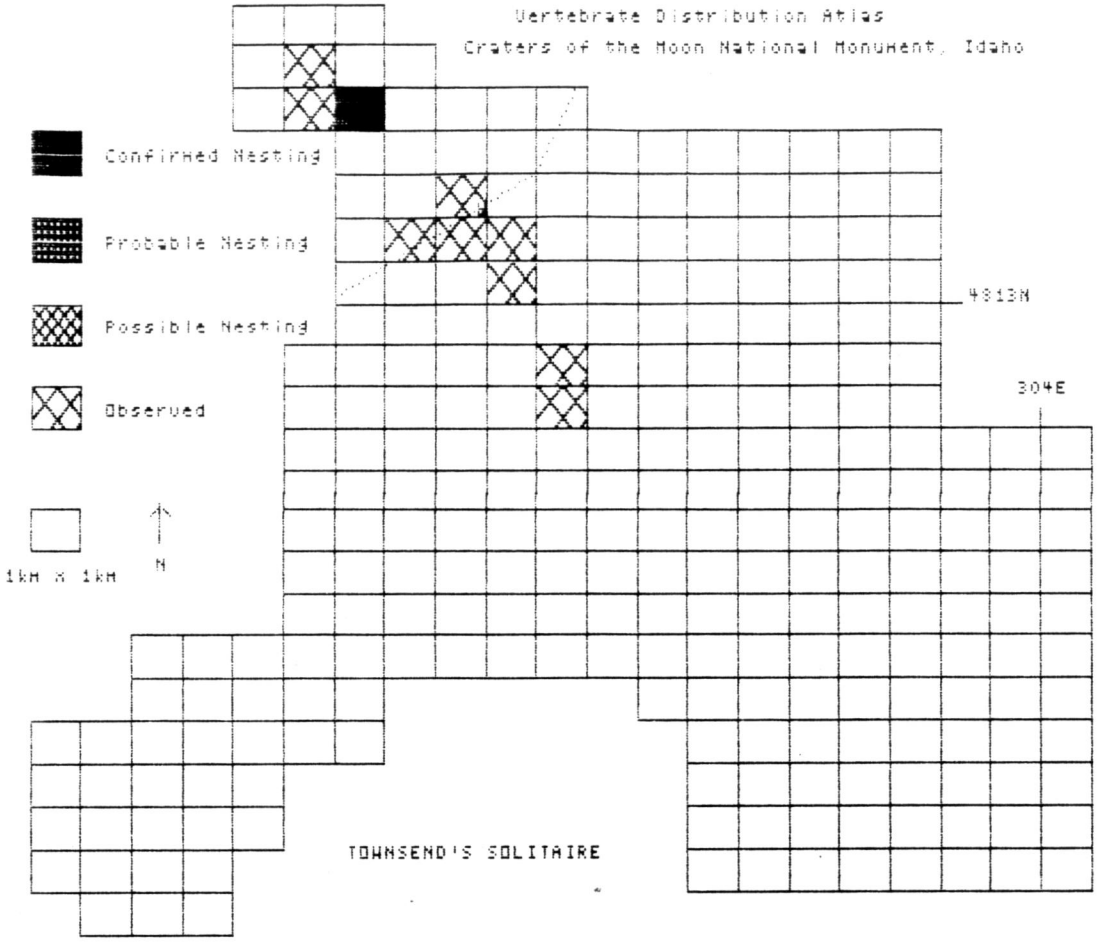

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
AMERICAN DIPPER

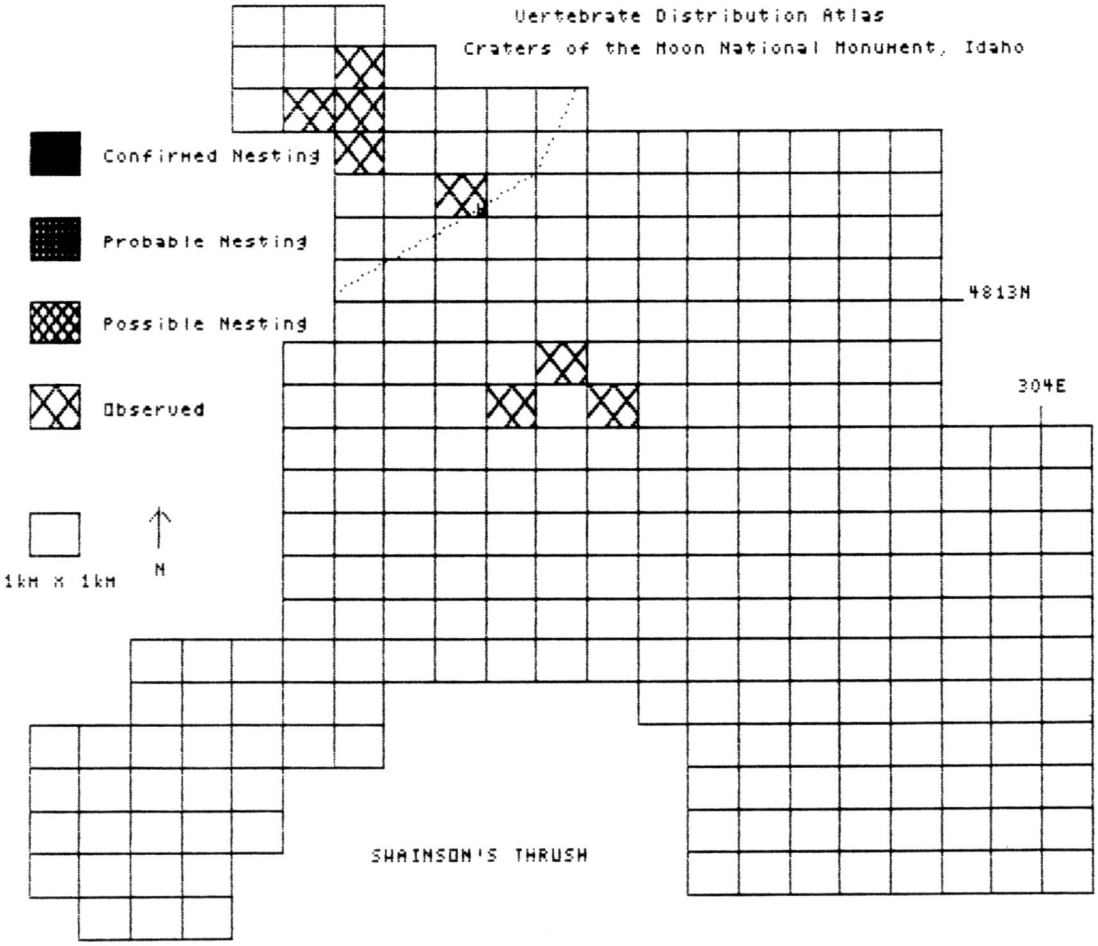

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
GOLDEN-CROWNED KINGLET

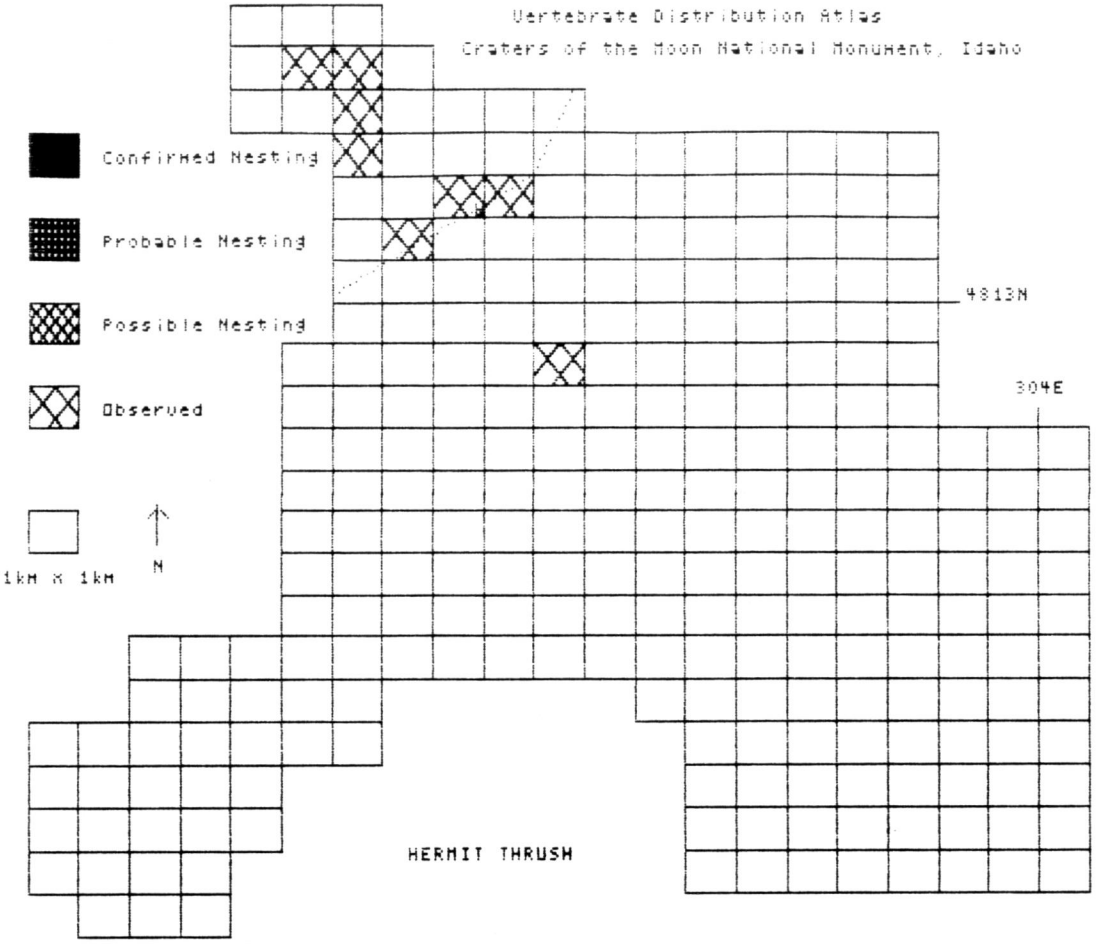

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
RUBY-CROWNED KINGLET

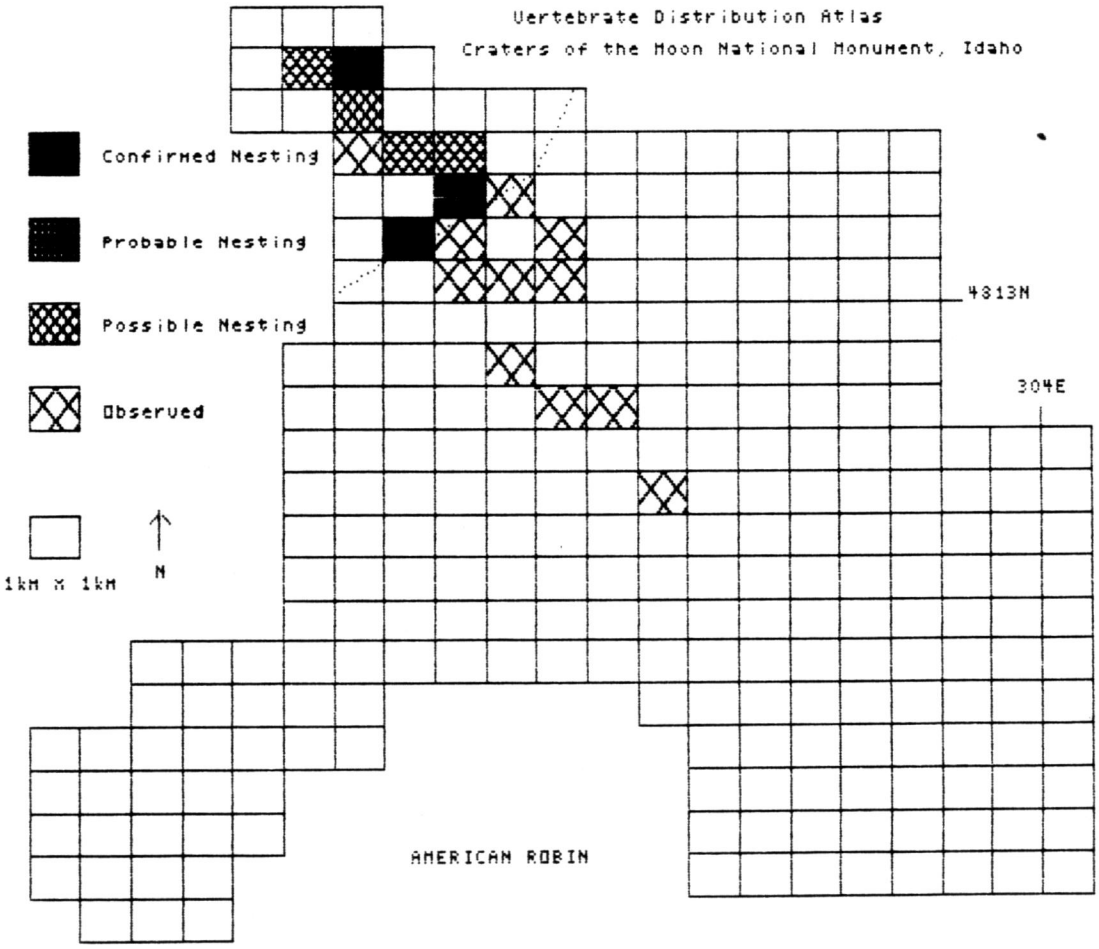

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WESTERN BLUEBIRD

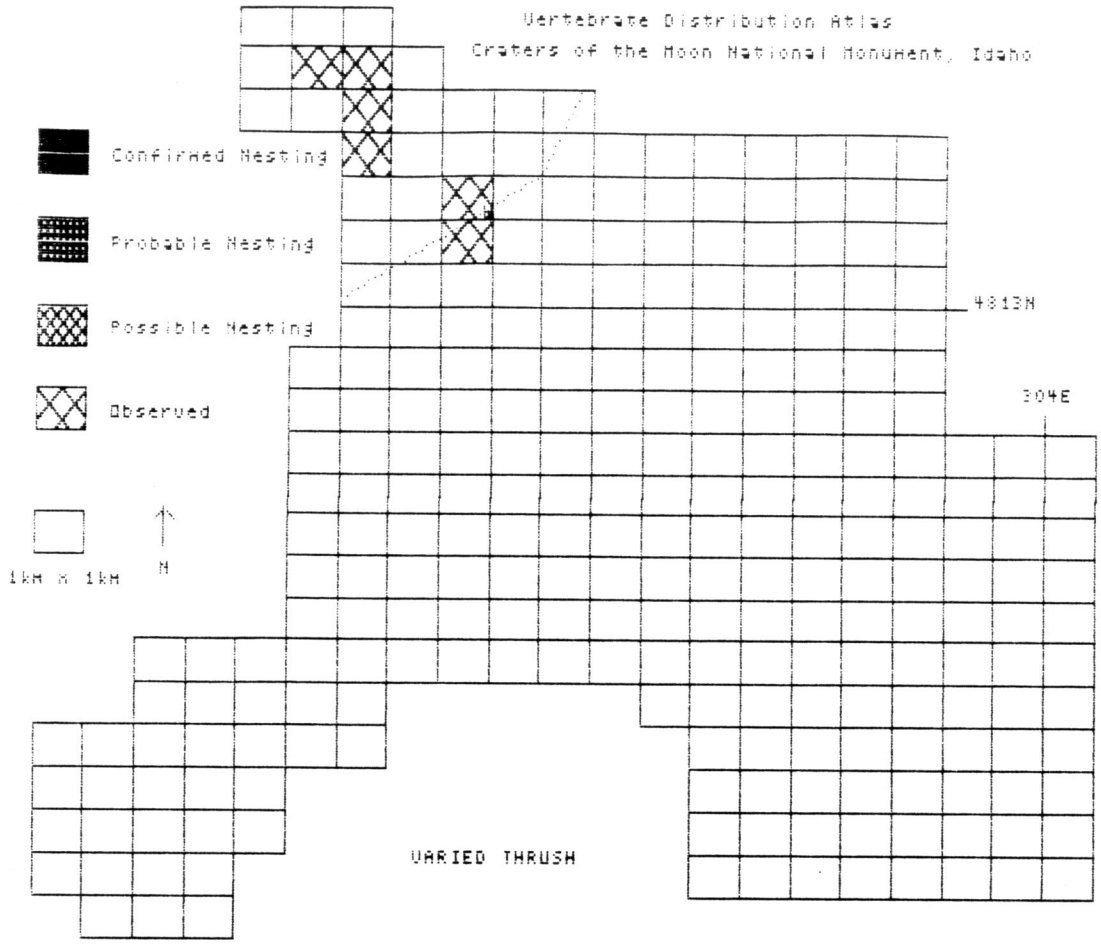

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
MOUNTAIN BLUEBIRD

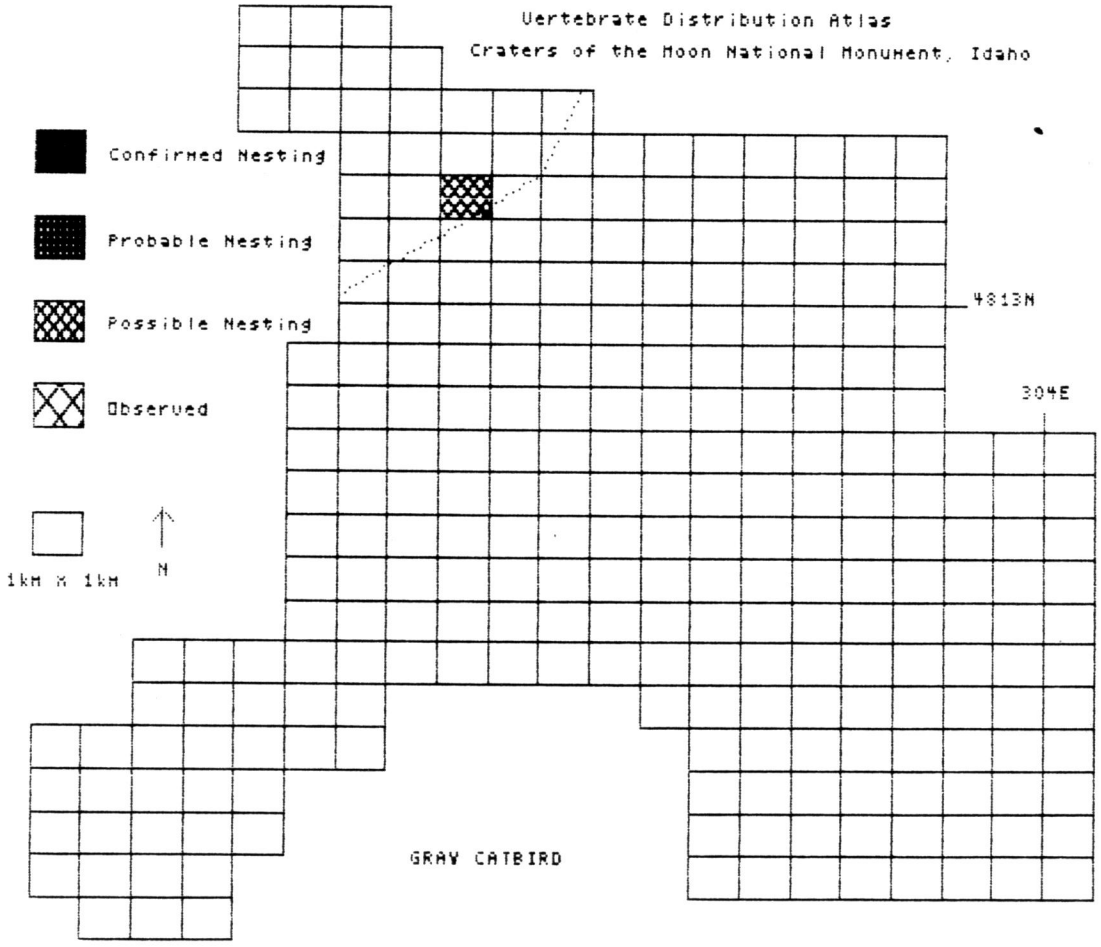

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
TOWNSEND'S SOLITAIRE

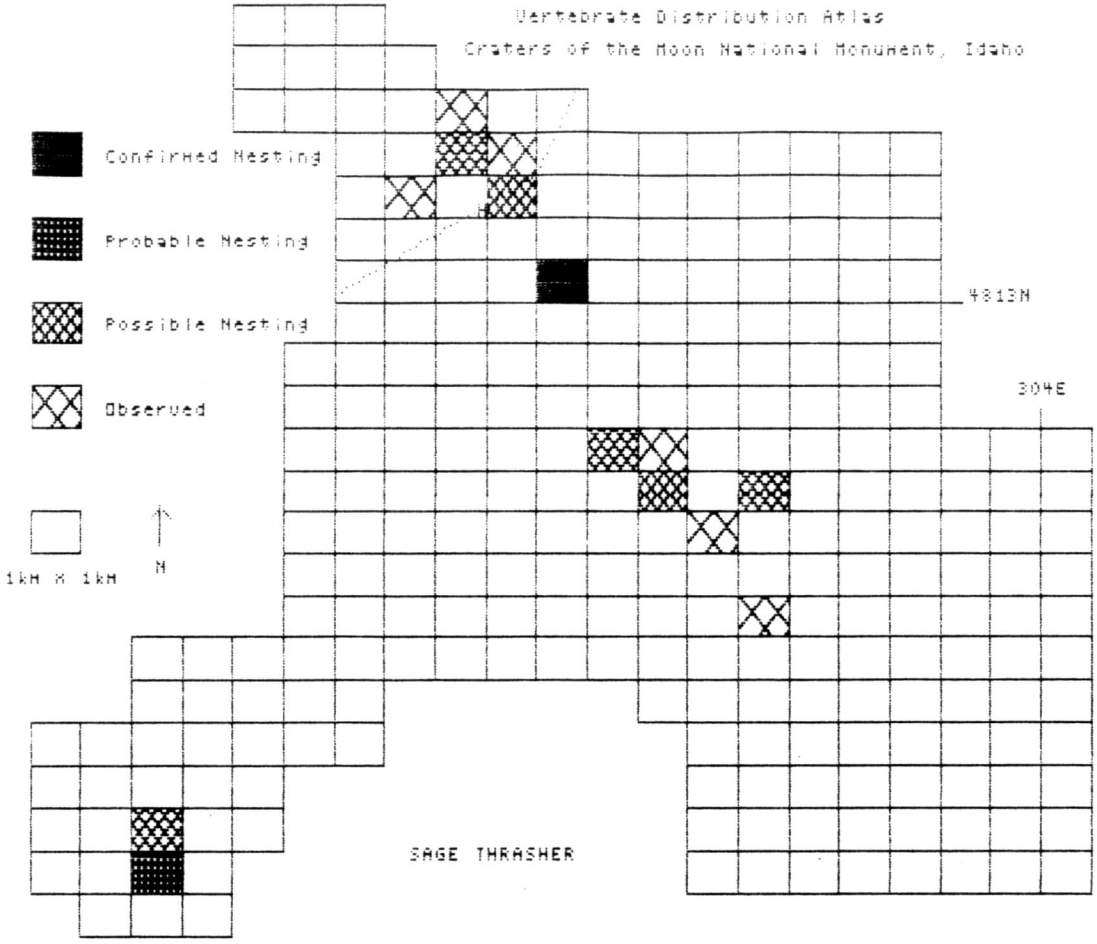

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
SWAINSON'S THRUSH

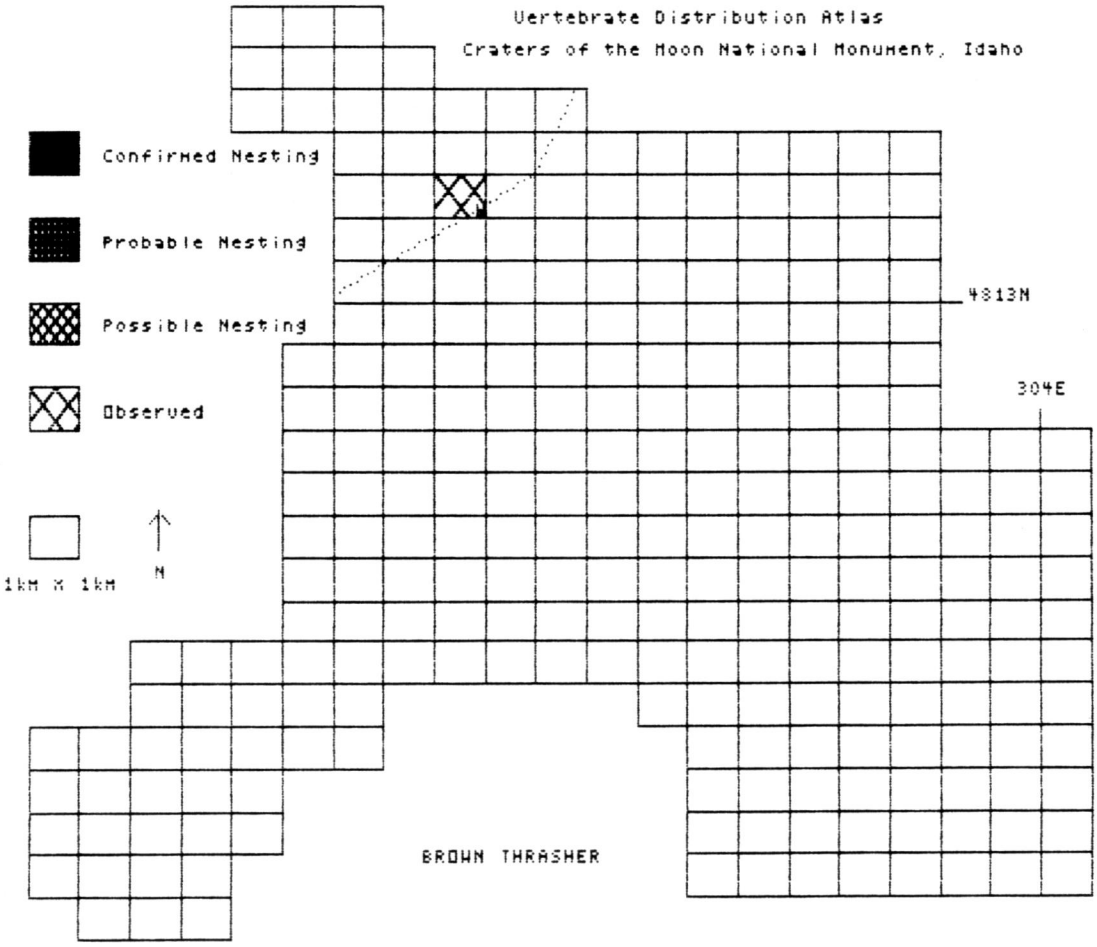

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
HERMIT THRUSH

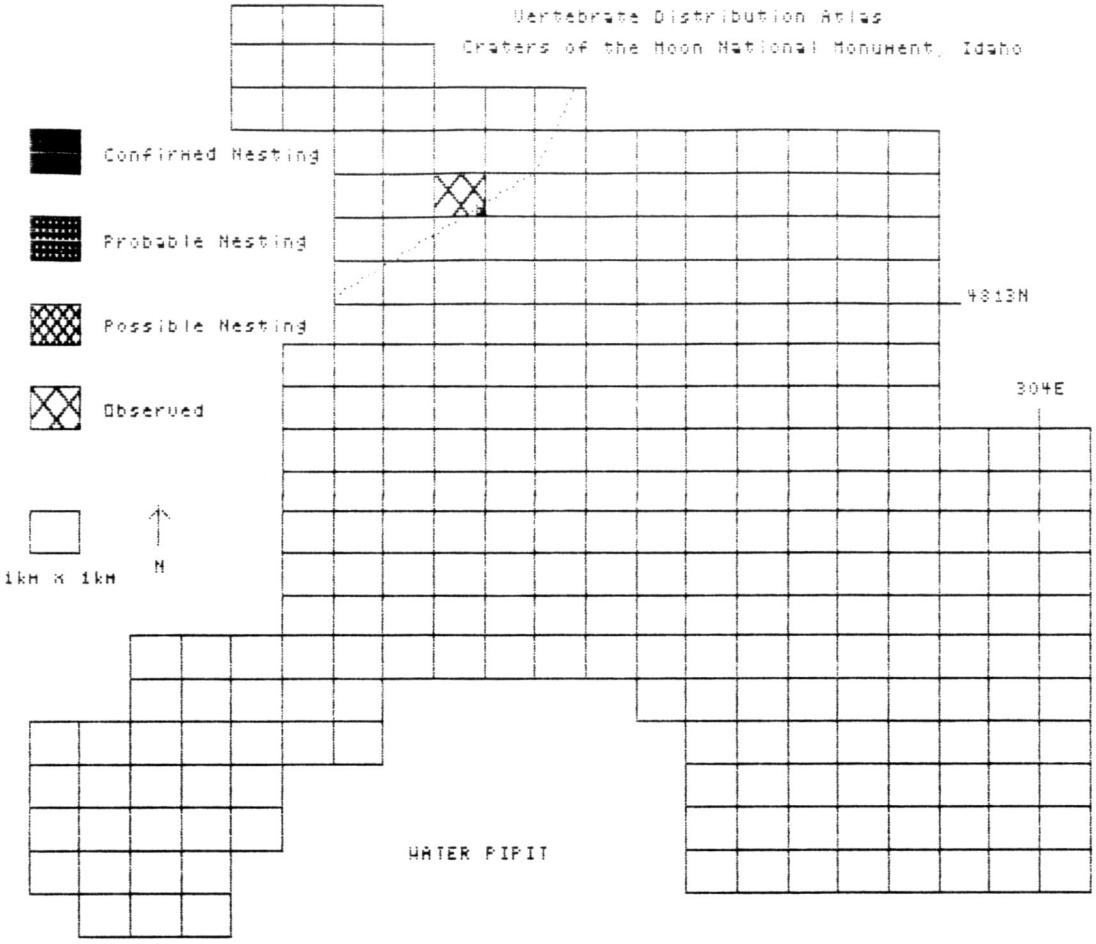

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
AMERICAN ROBIN

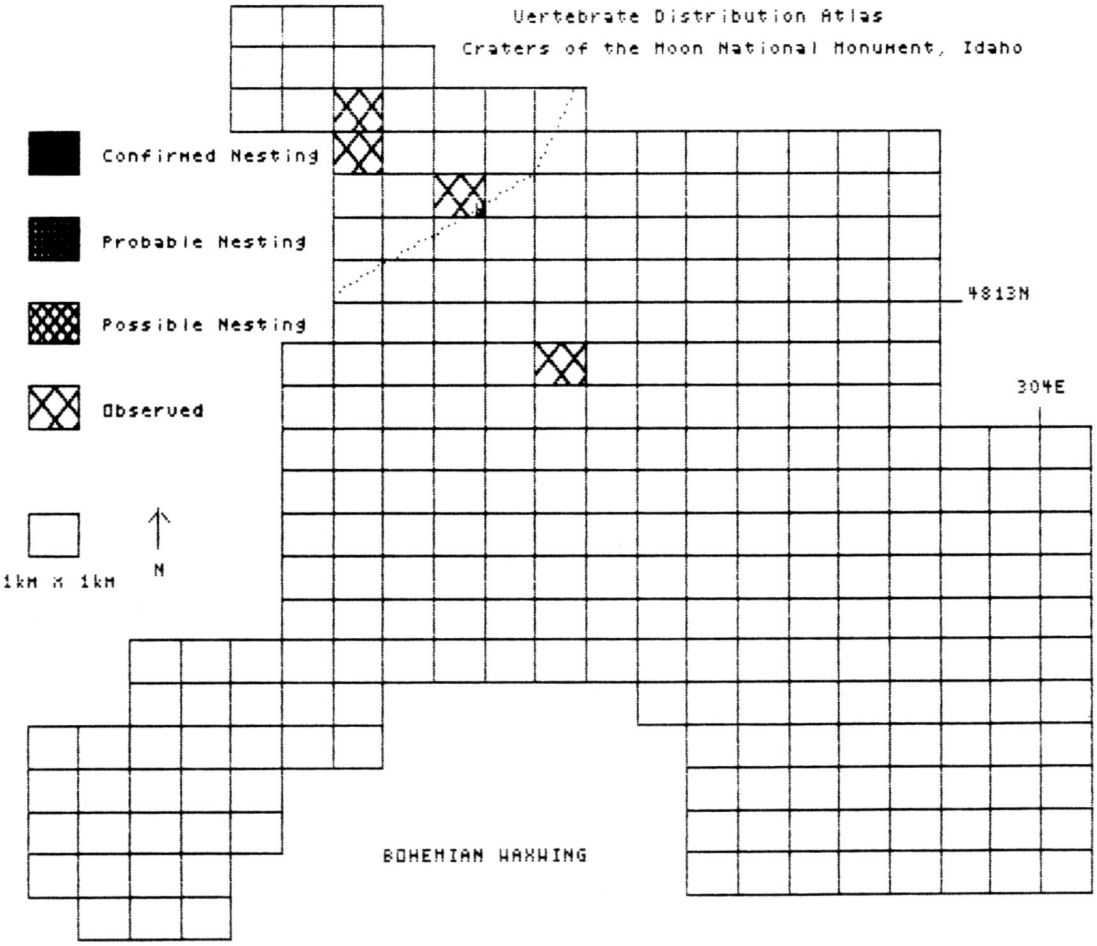

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
VARIED THRUSH

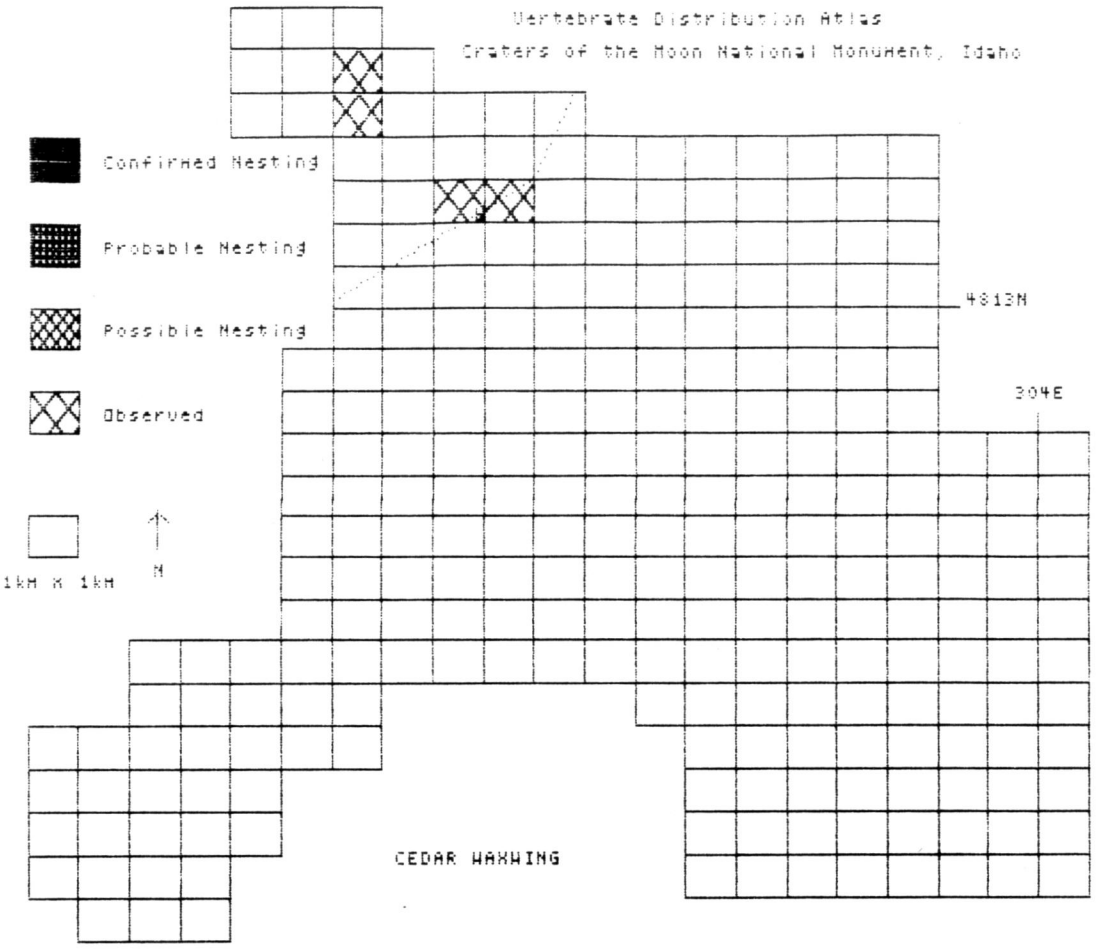

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
GRAY CATBIRD

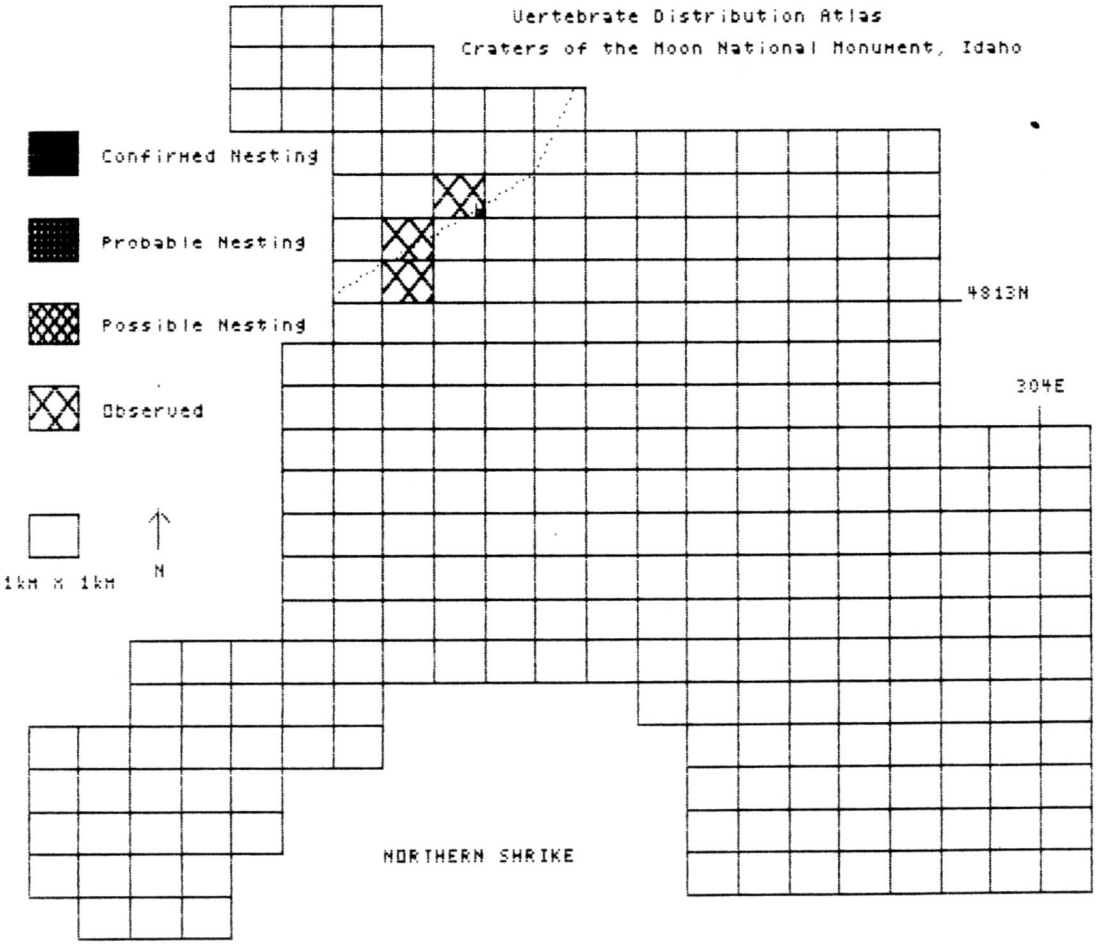

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
SAGE THRASHER

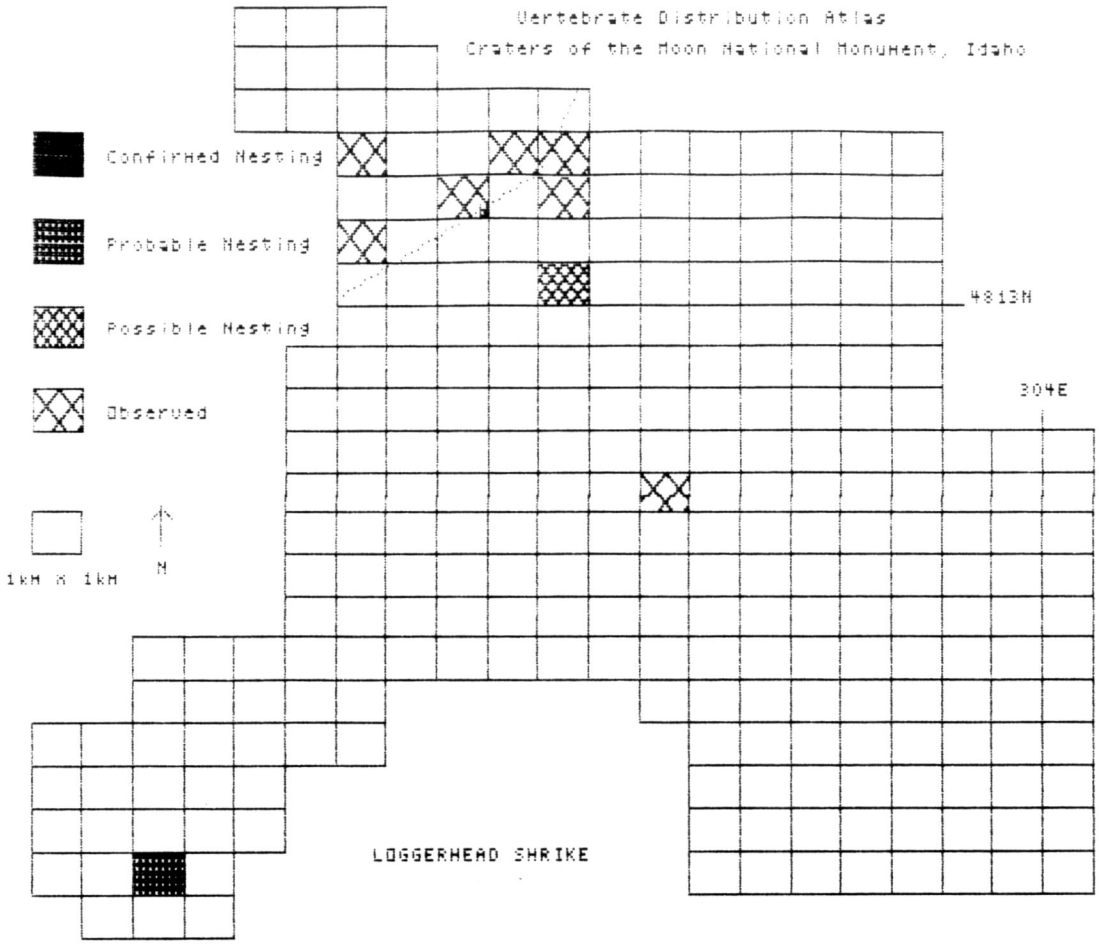

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
BROWN THRASHER

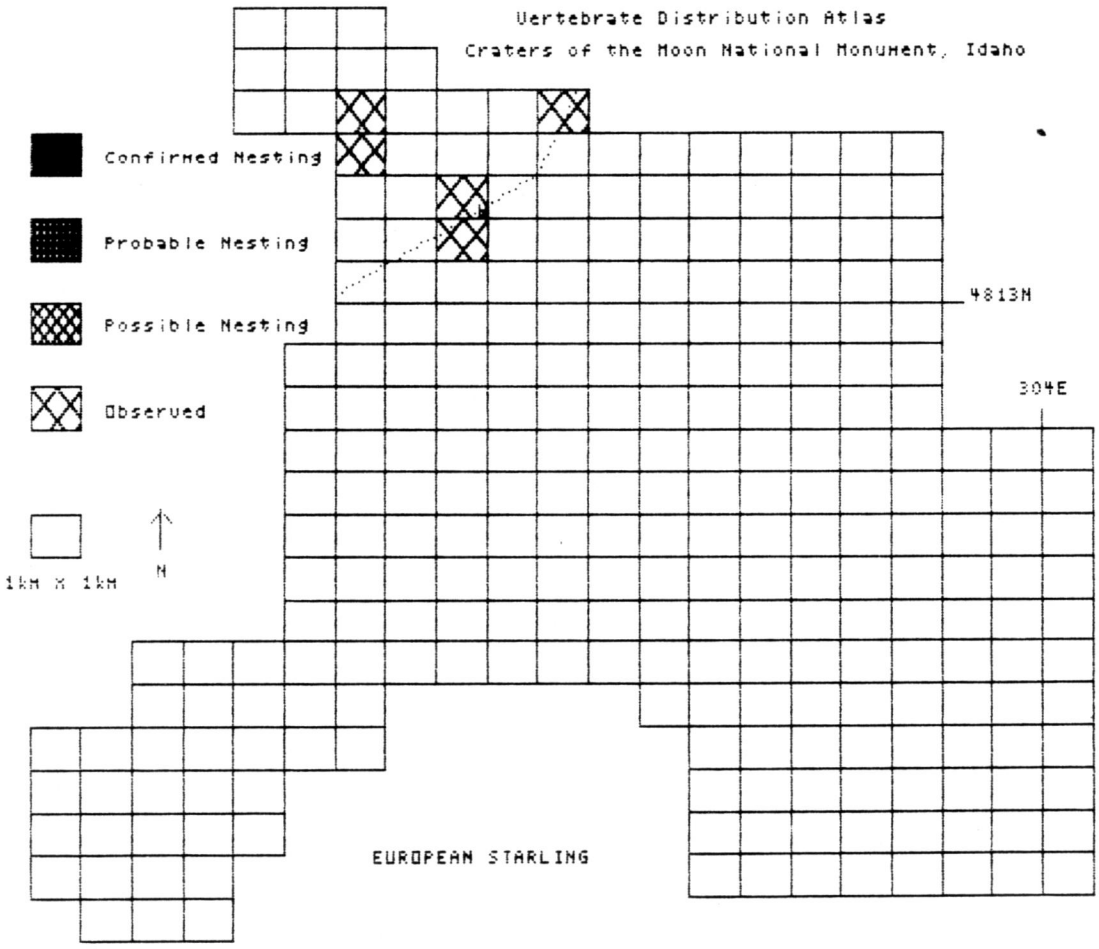

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WATER PIPIT

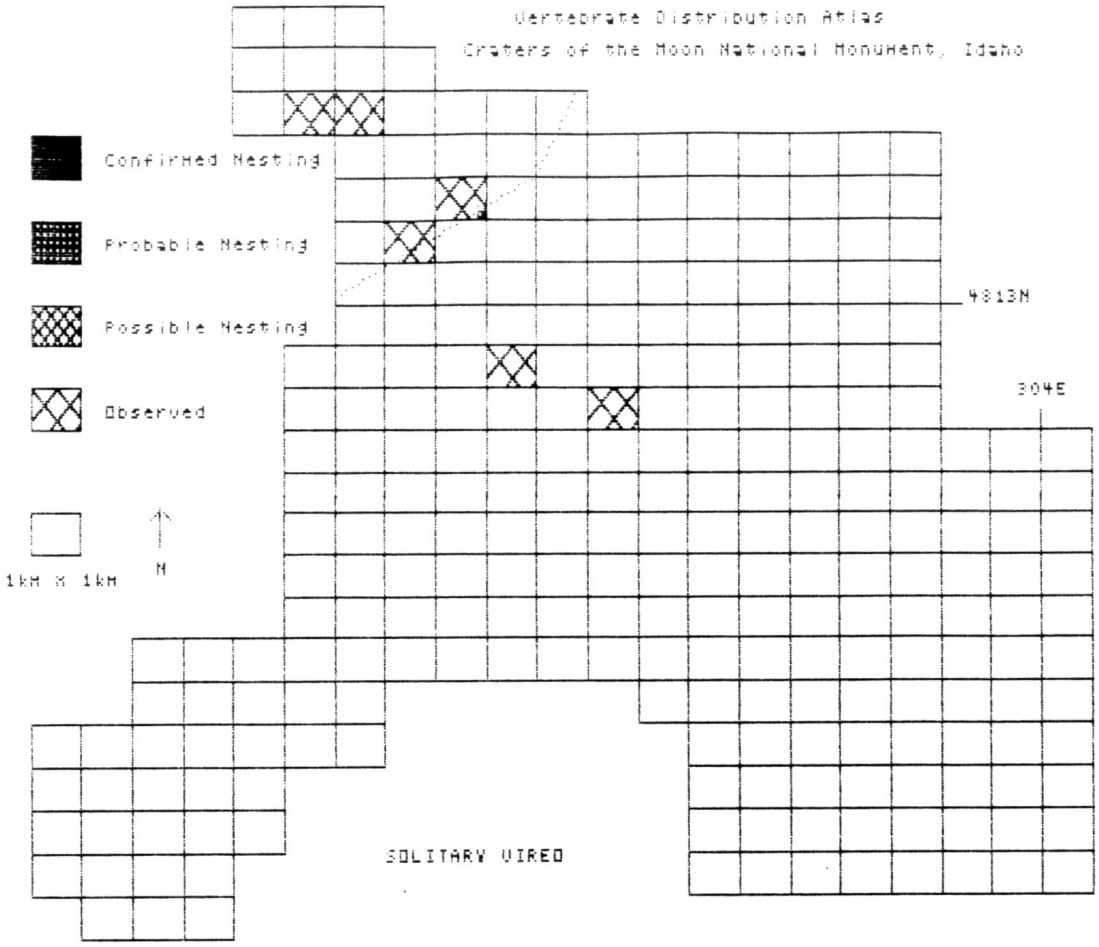

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
BOHEMIAN WAXWING

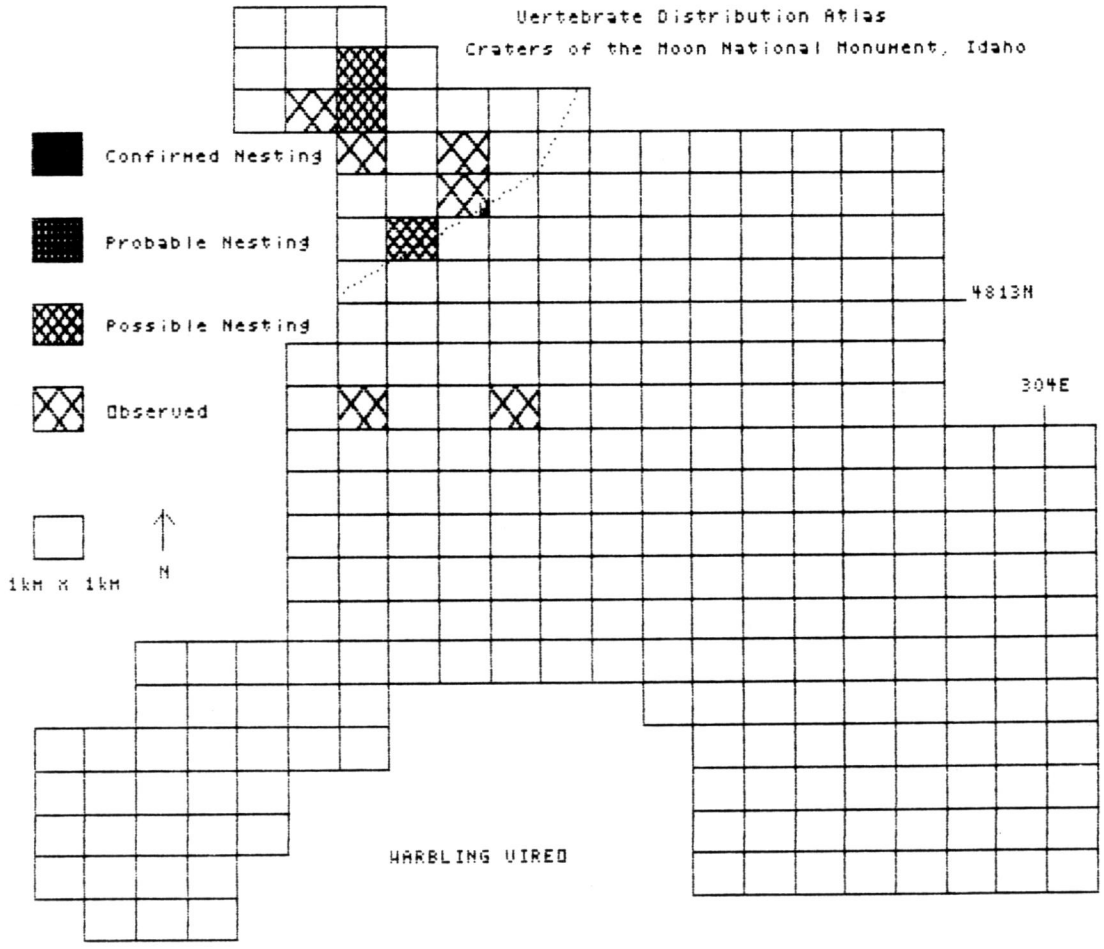

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1kM x 1kM
N
CEDAR WAXWING

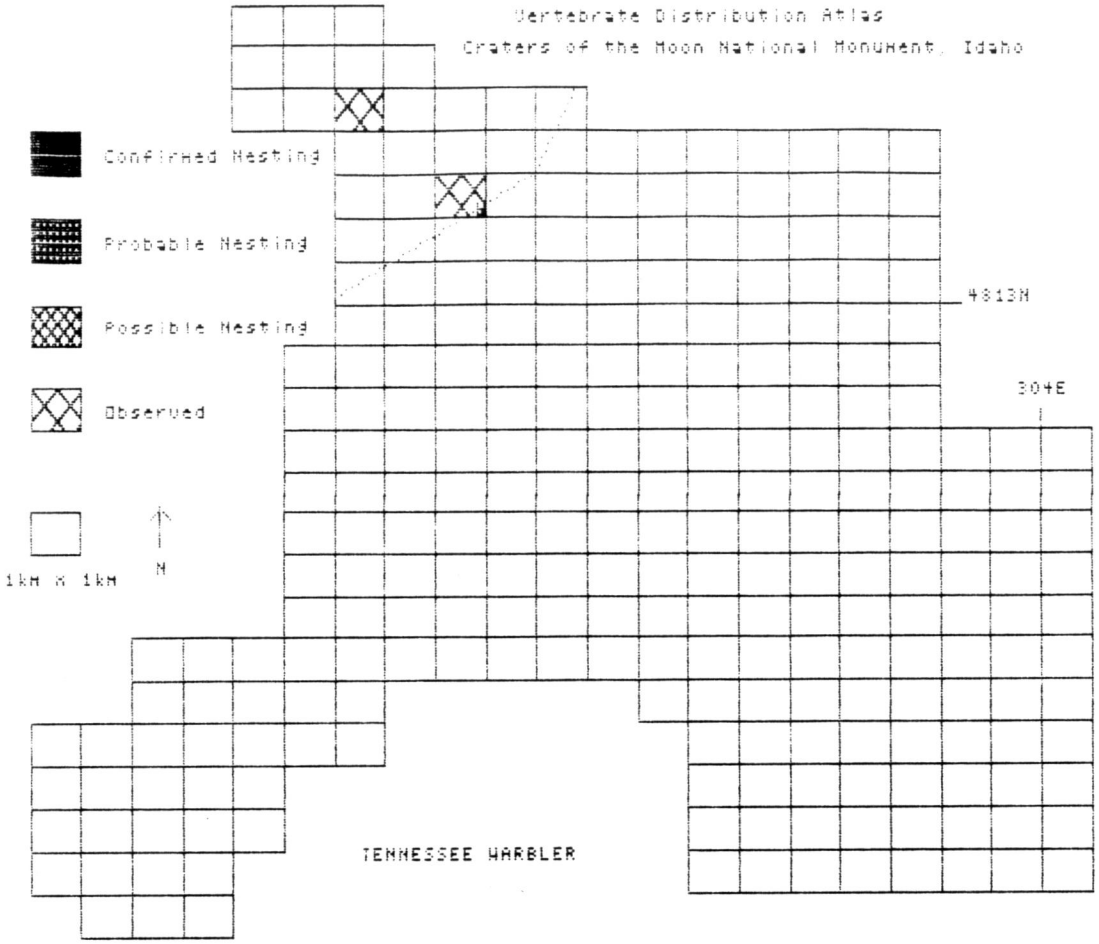

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1kM x 1kM
N
NORTHERN SHRIKE

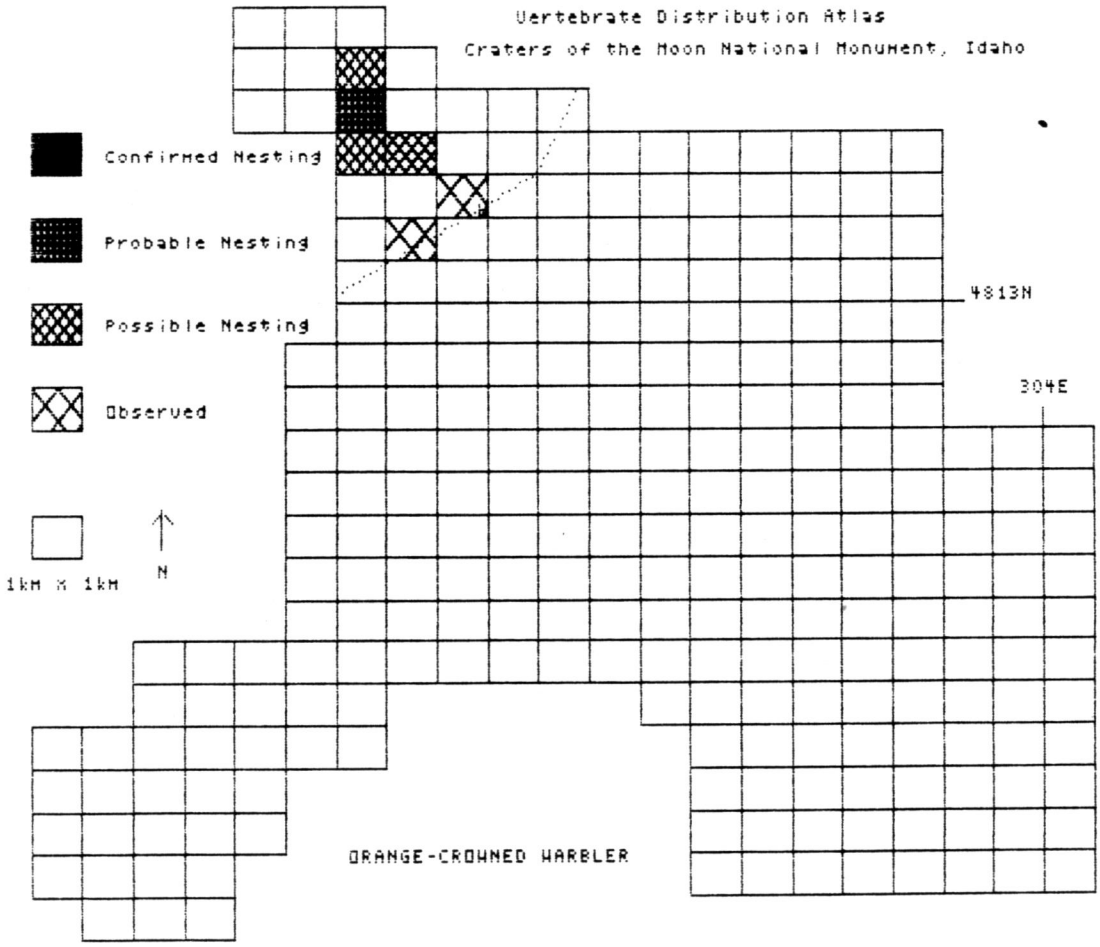

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
LOGGERHEAD SHRIKE

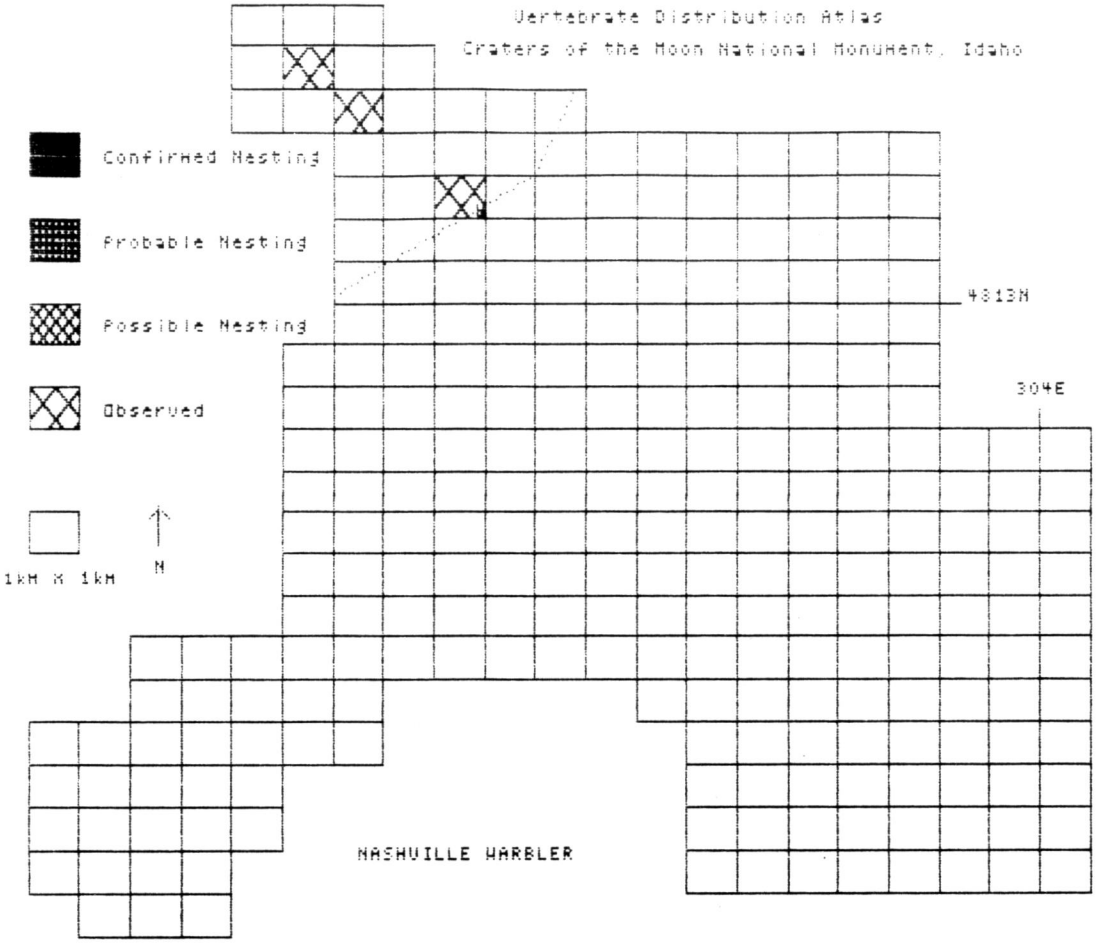

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
EUROPEAN STARLING

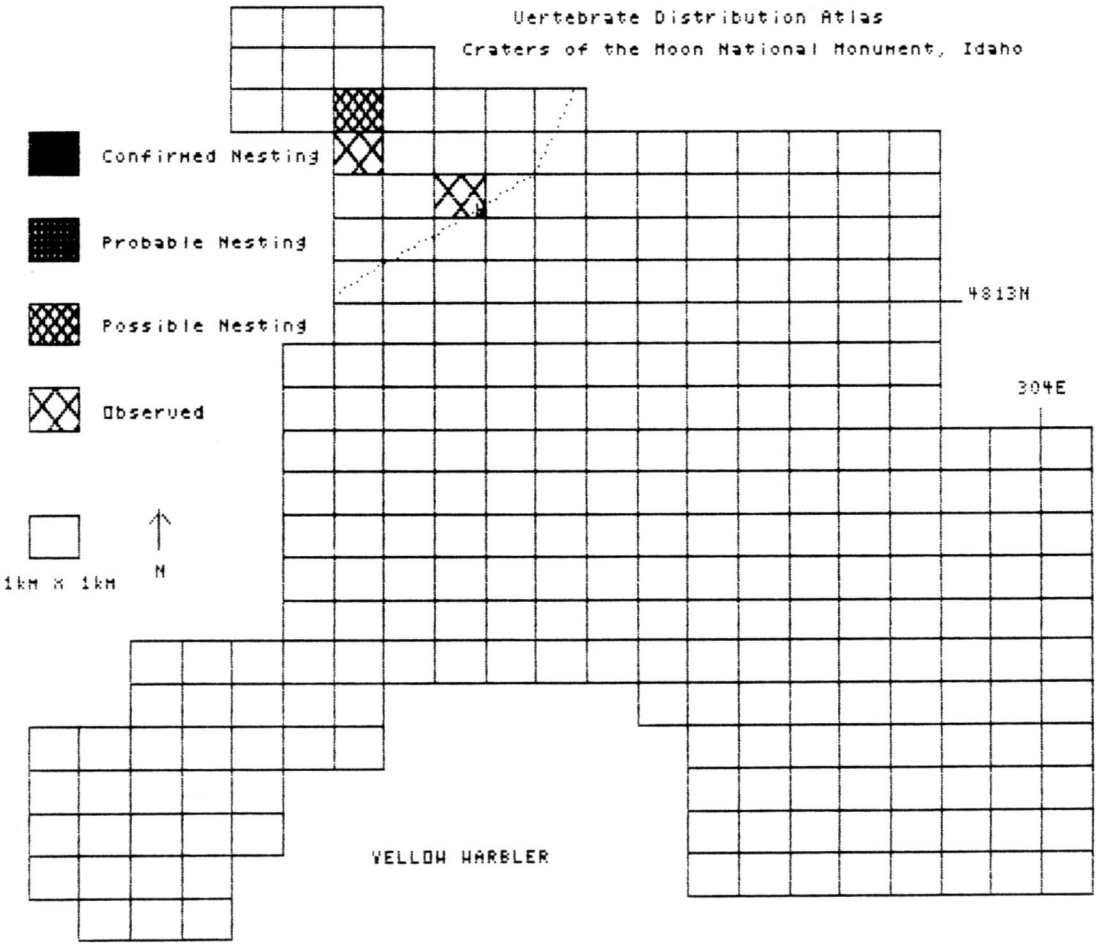

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1kM x 1kM
N
SOLITARY VIREO

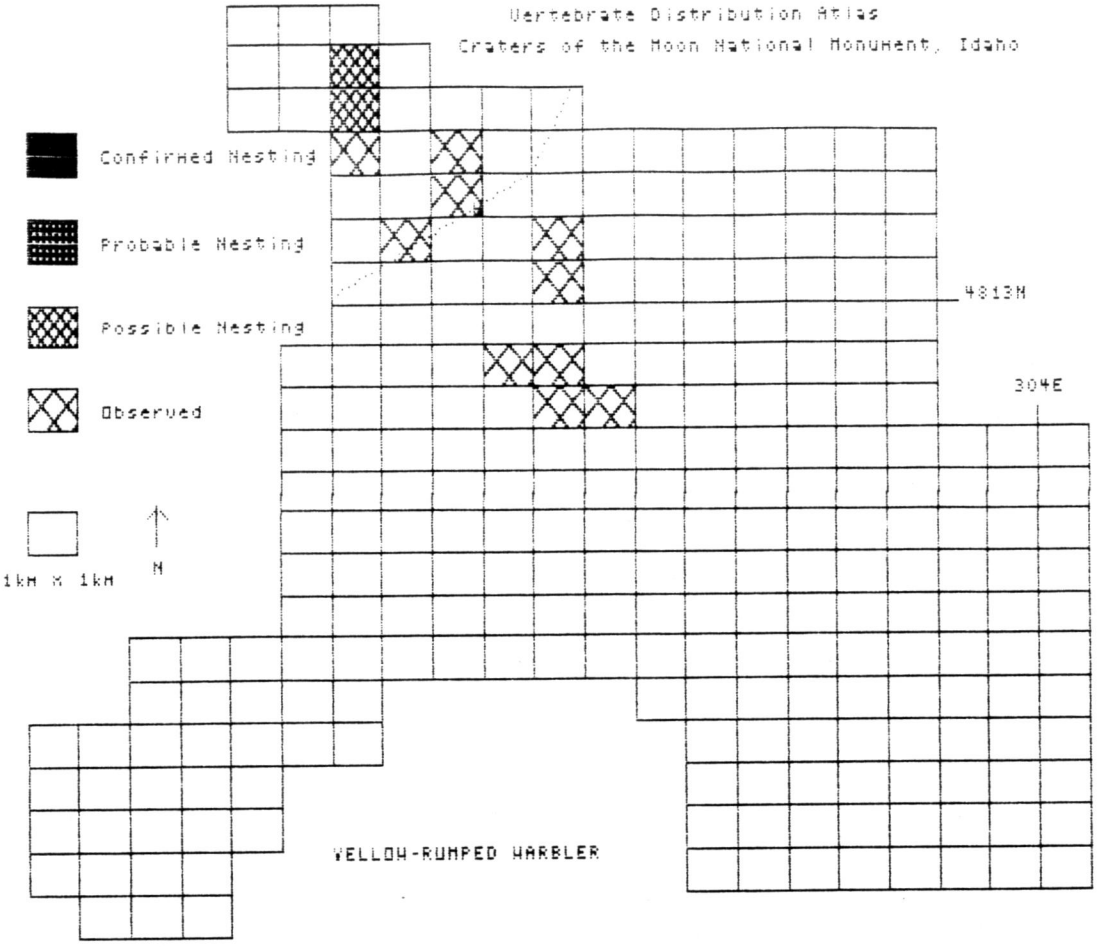

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1kM x 1kM
N
WARBLING VIREO

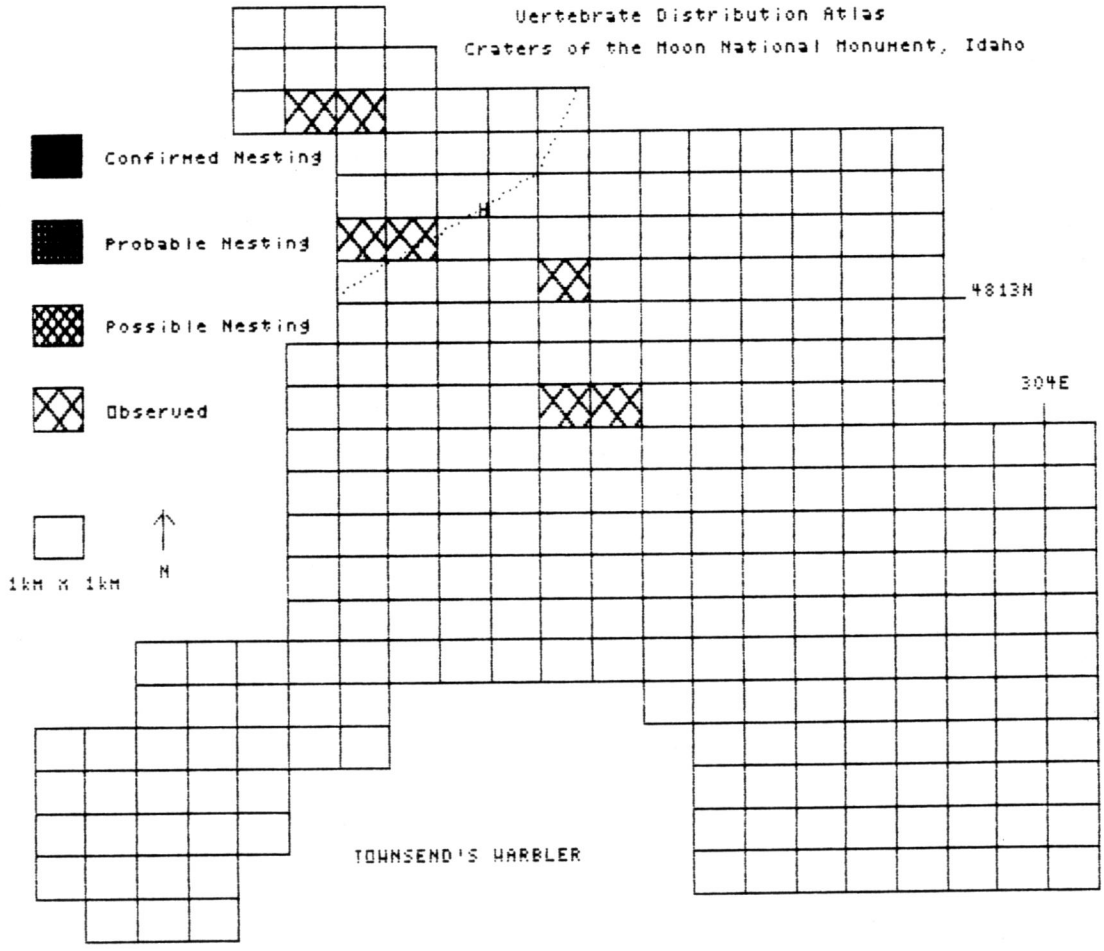

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
TENNESSEE WARBLER

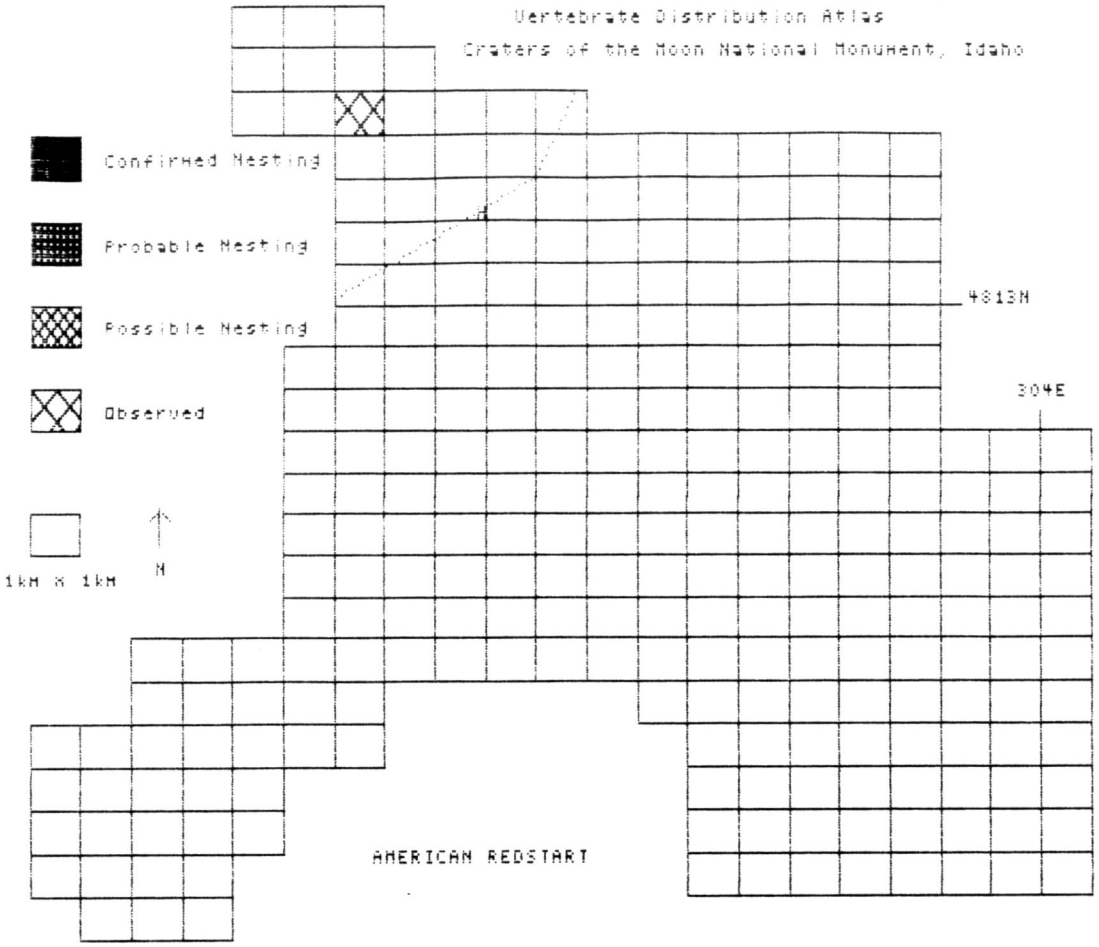

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
ORANGE-CROWNED WARBLER

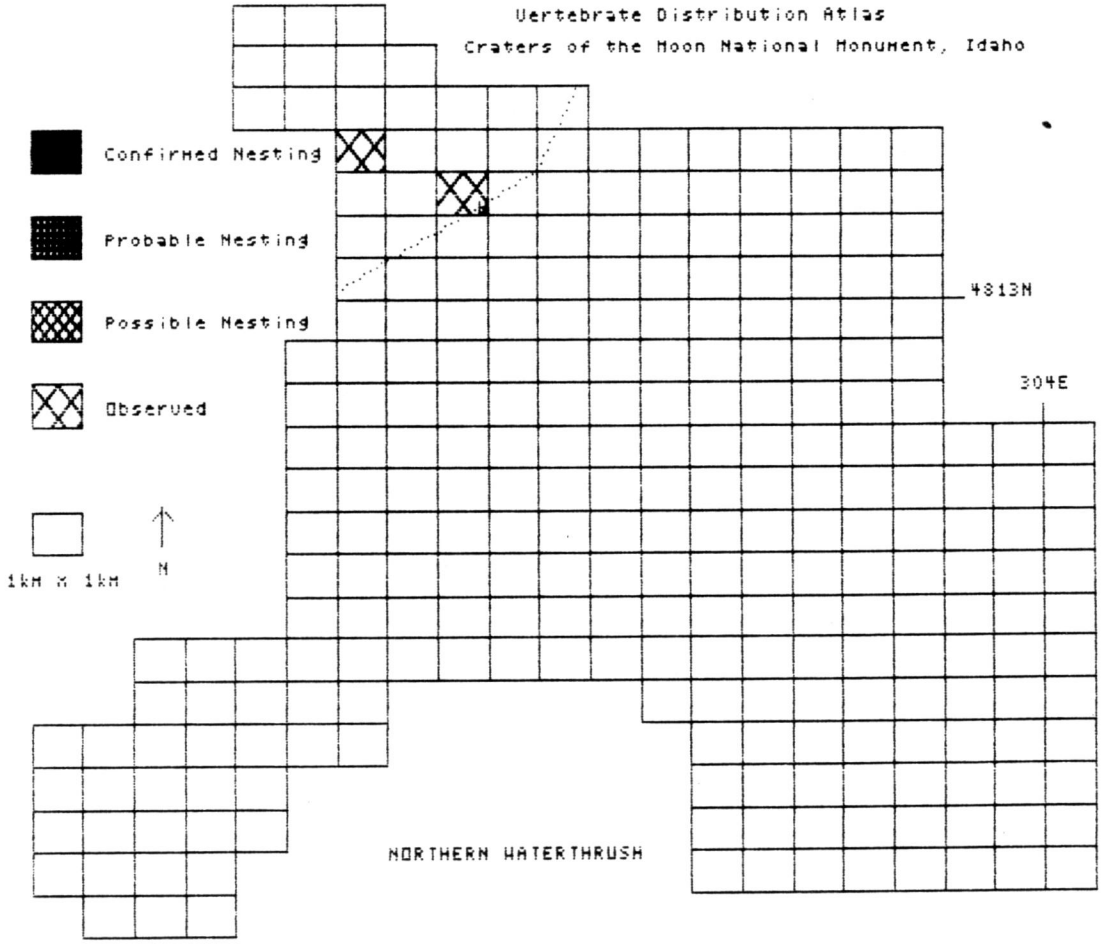

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
NASHVILLE WARBLER

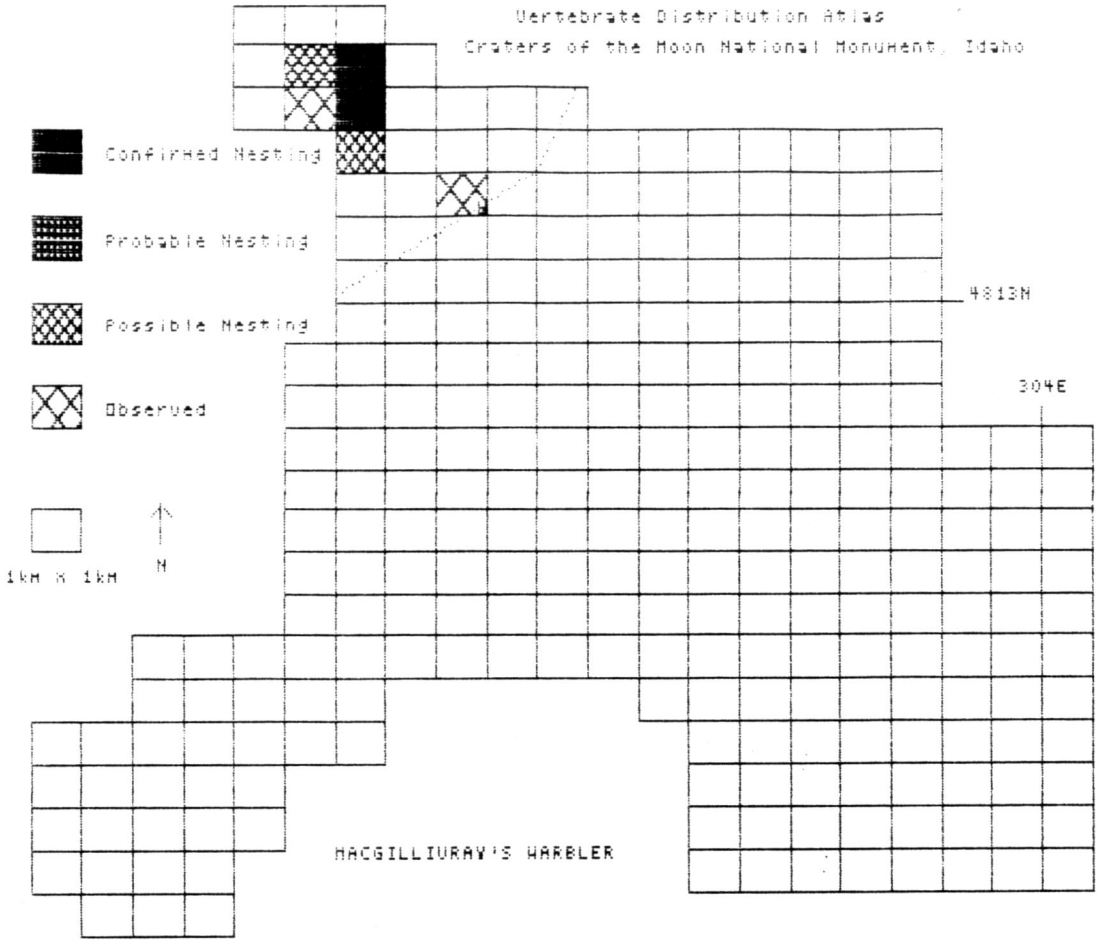

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
YELLOW WARBLER

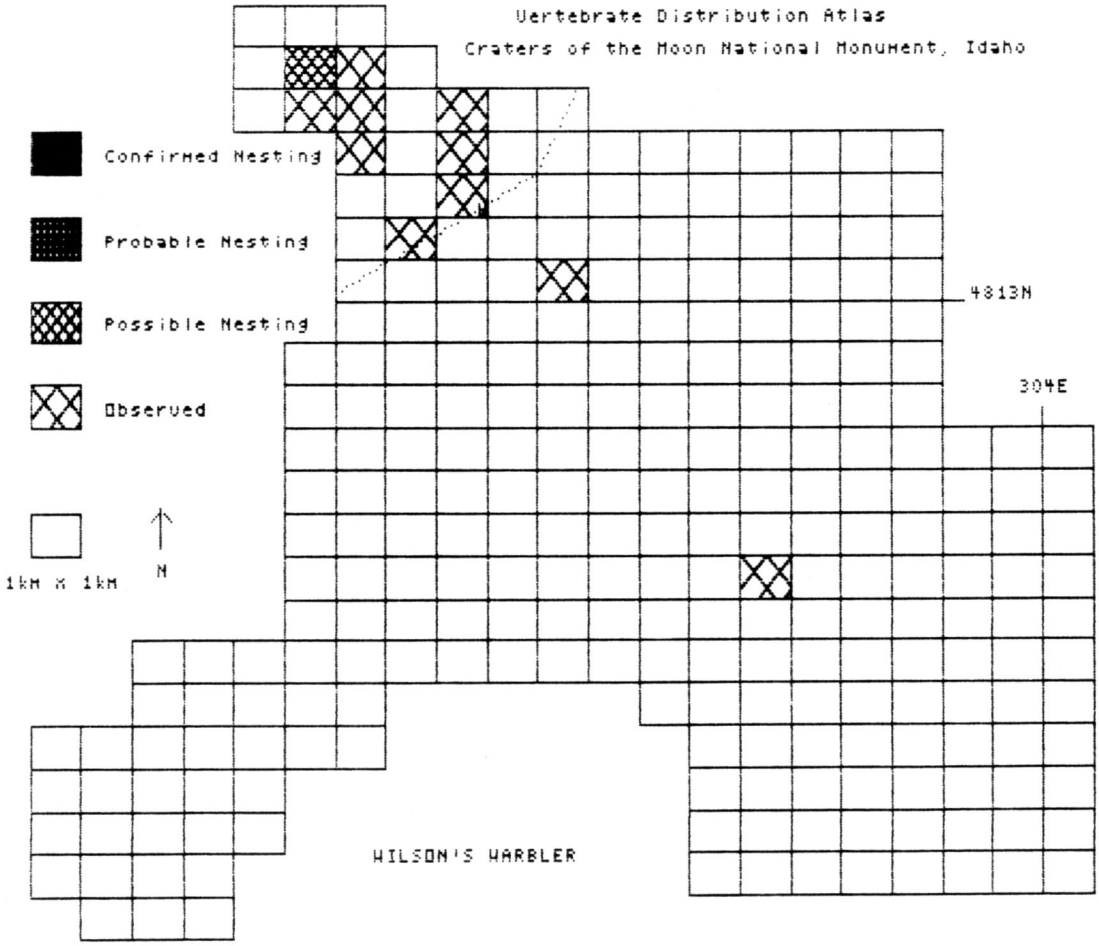

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
YELLOW-RUMPED WARBLER

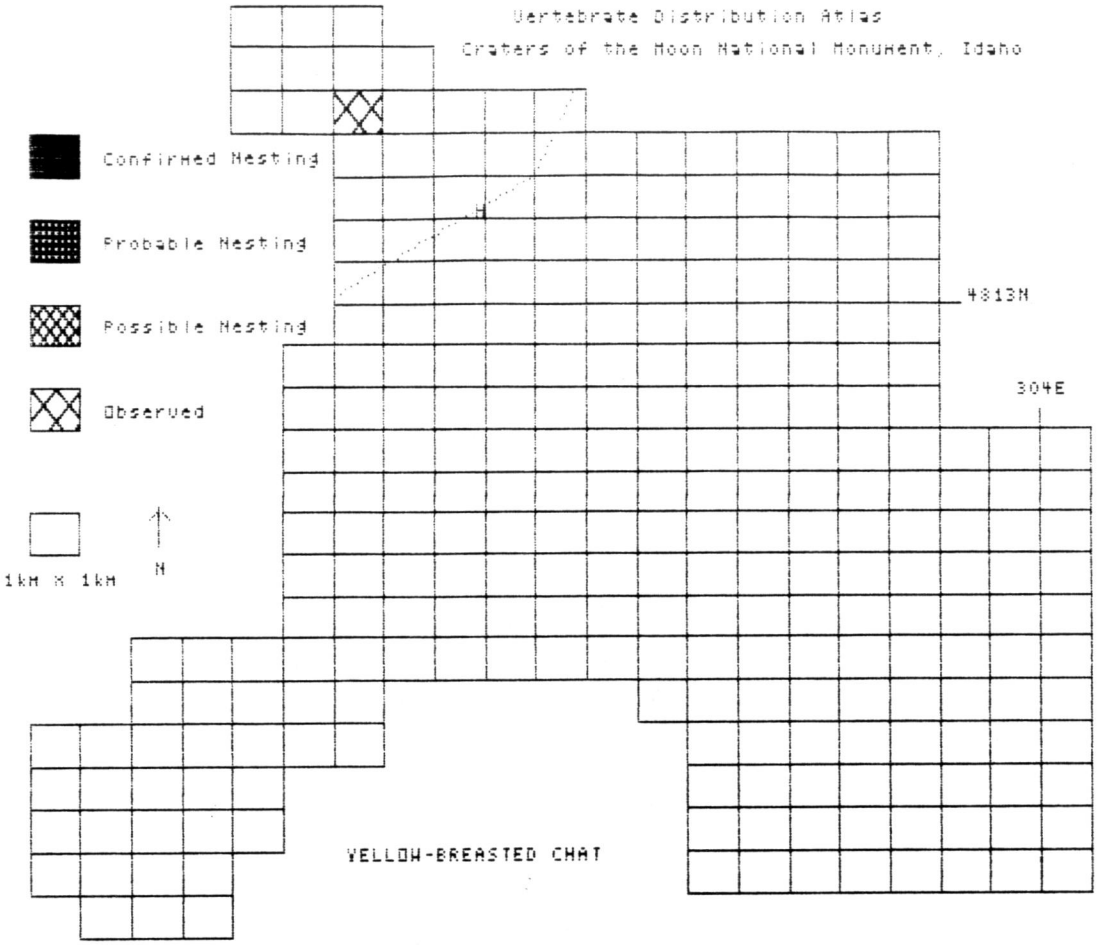

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
TOWNSEND'S WARBLER

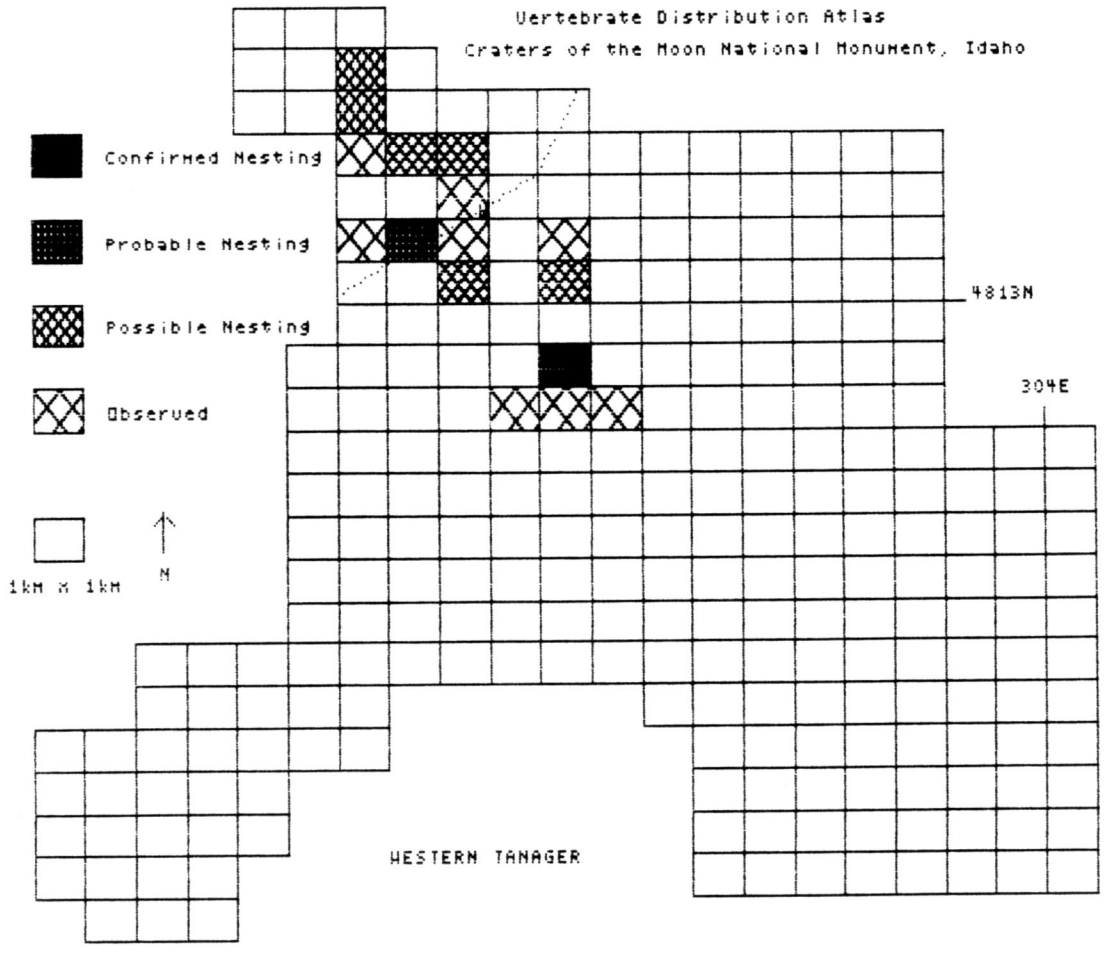

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
AMERICAN REDSTART

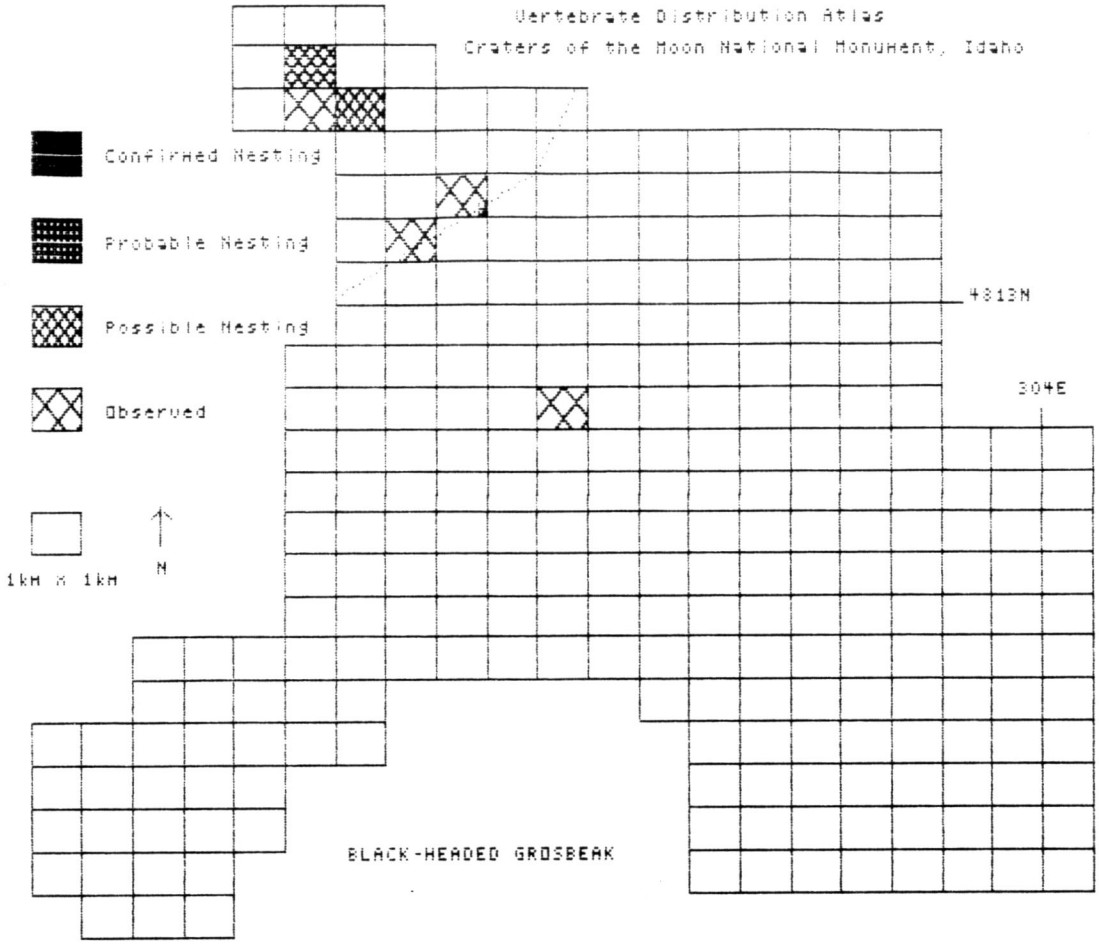

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
NORTHERN WATERTHRUSH

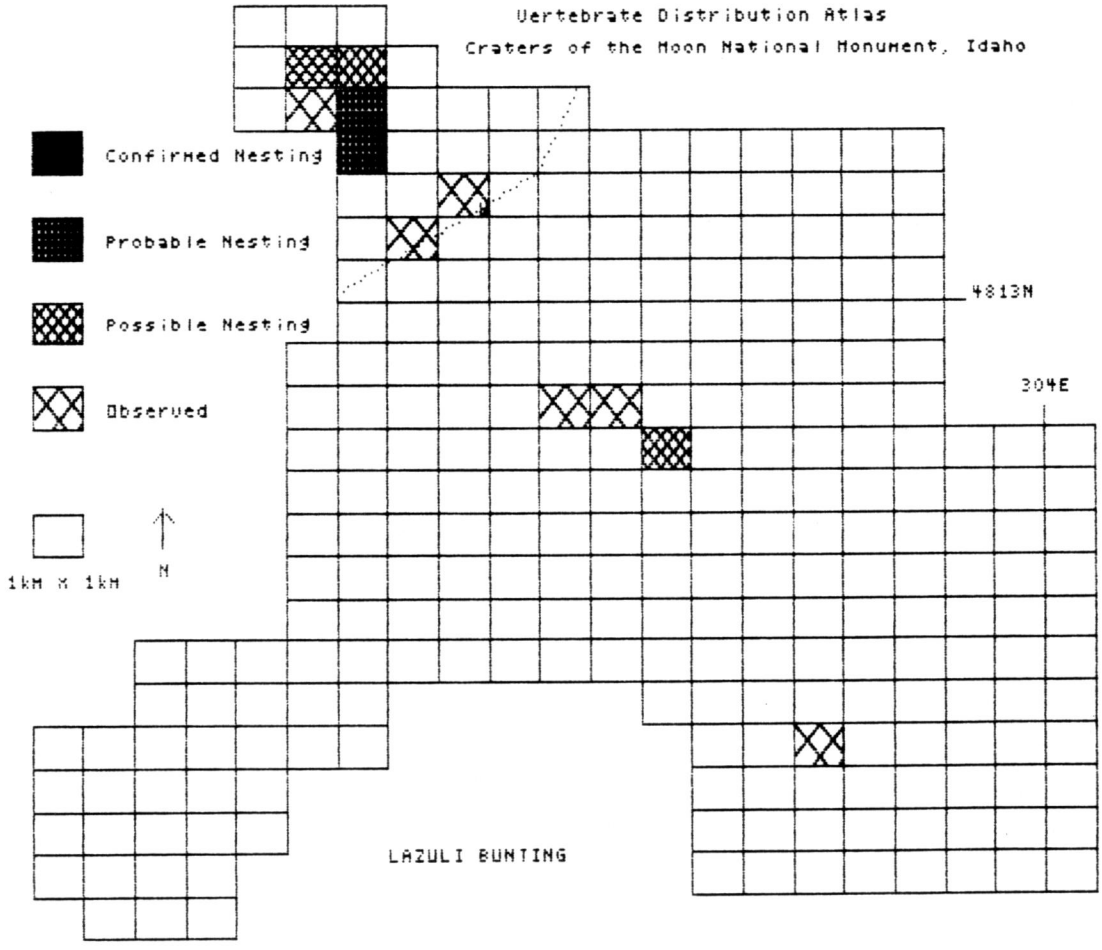

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
MACGILLIVRAY'S WARBLER

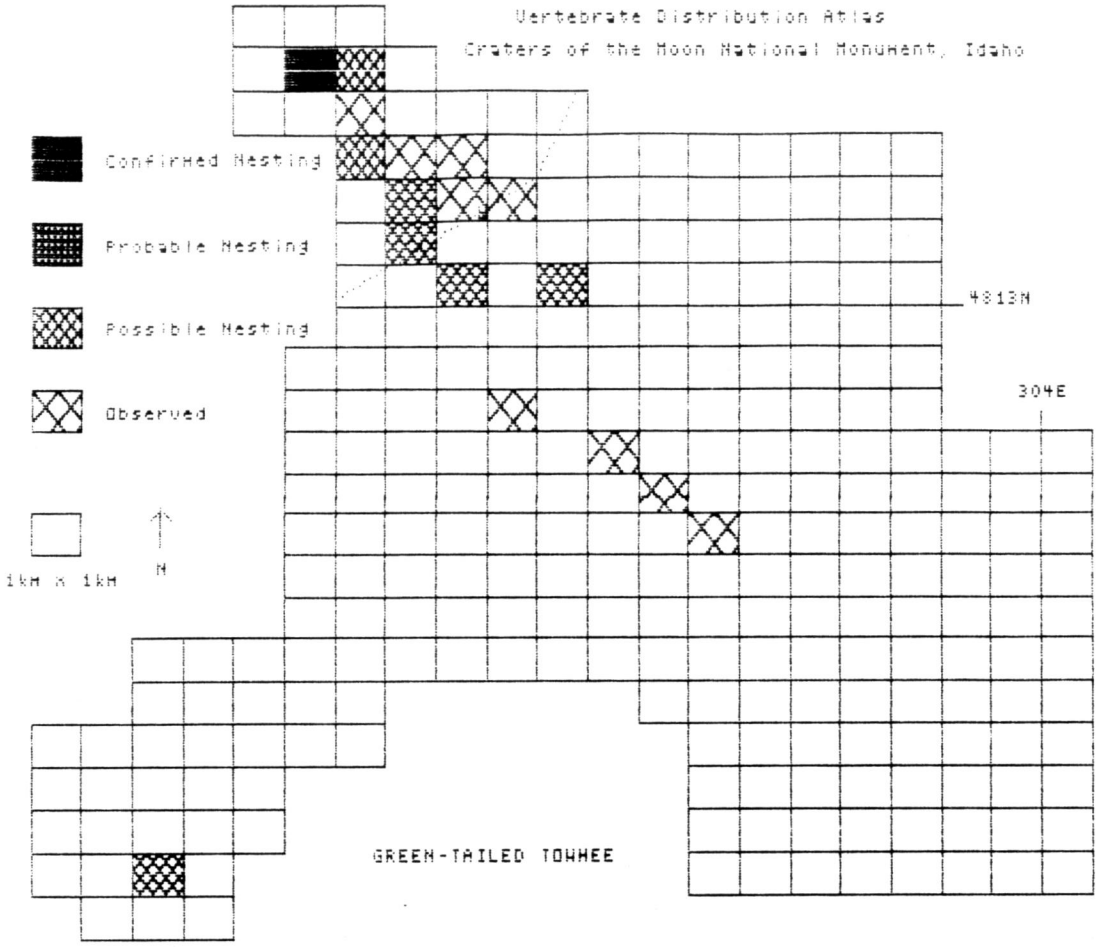

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WILSON'S WARBLER

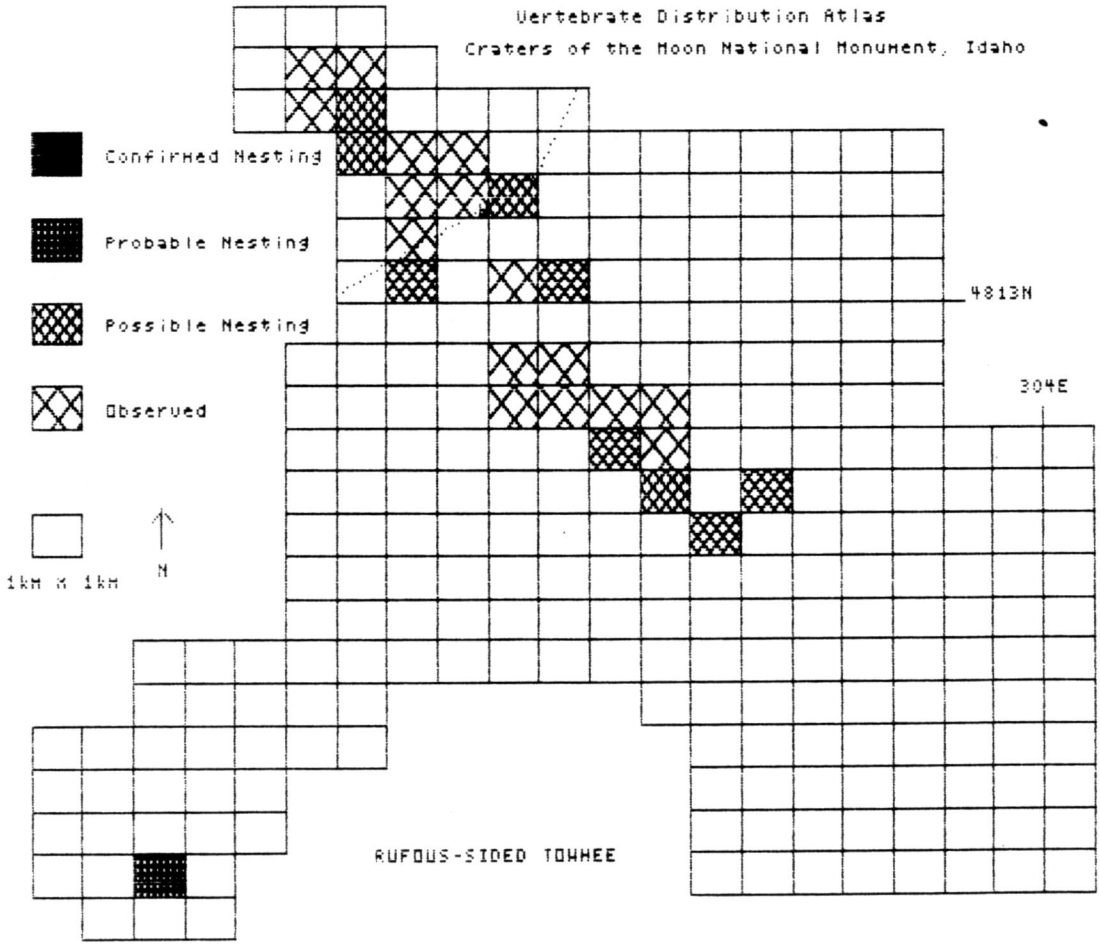

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM X 1kM
N
4813N
304E
YELLOW-BREASTED CHAT

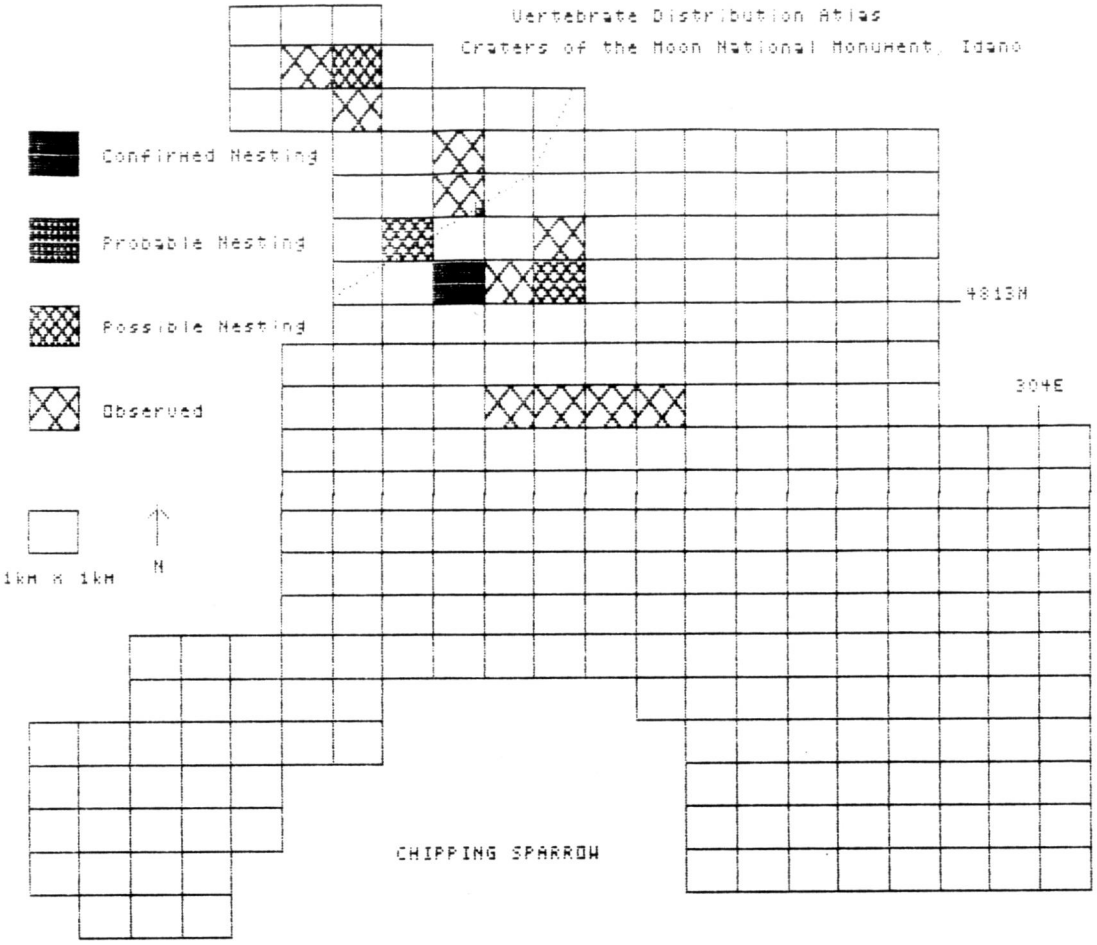

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM X 1kM
N
4813N
304E
WESTERN TANAGER

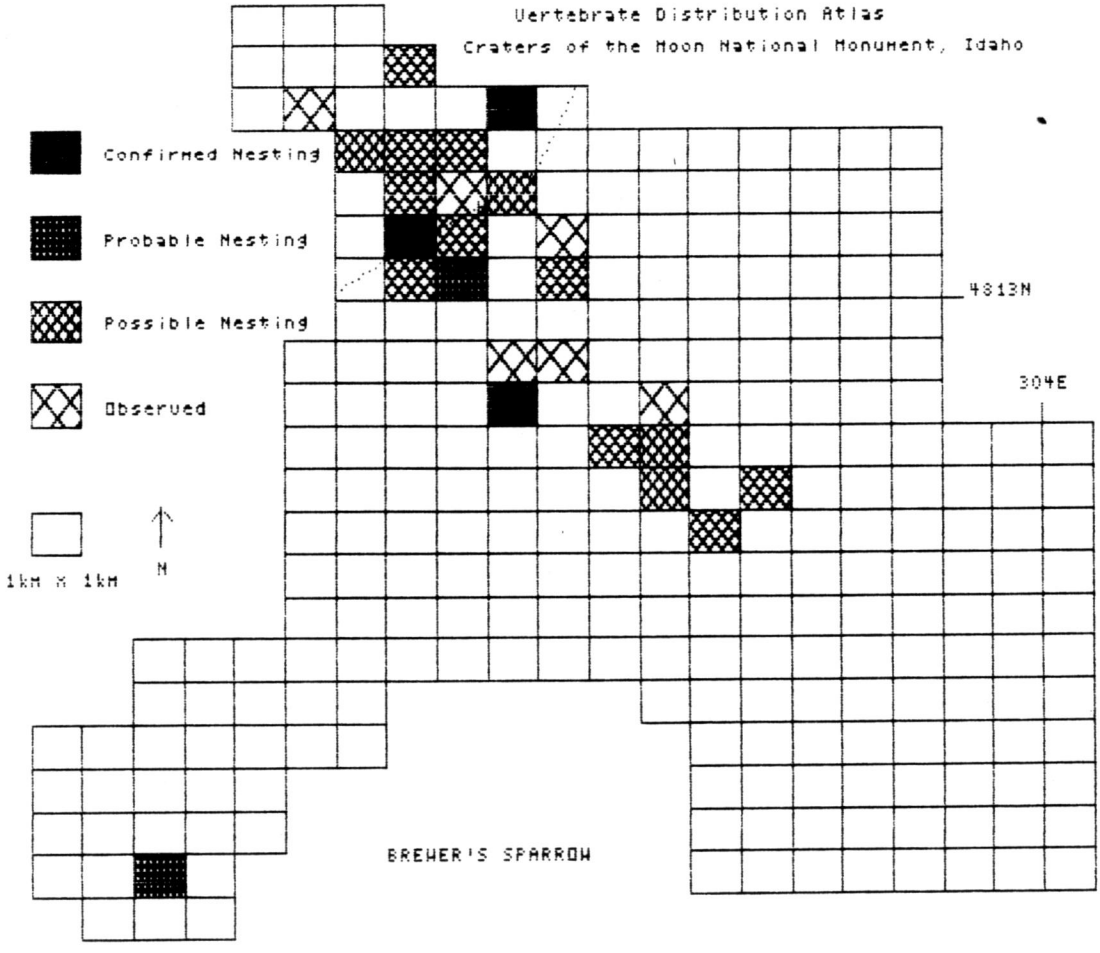

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
BLACK-HEADED GROSBEAK

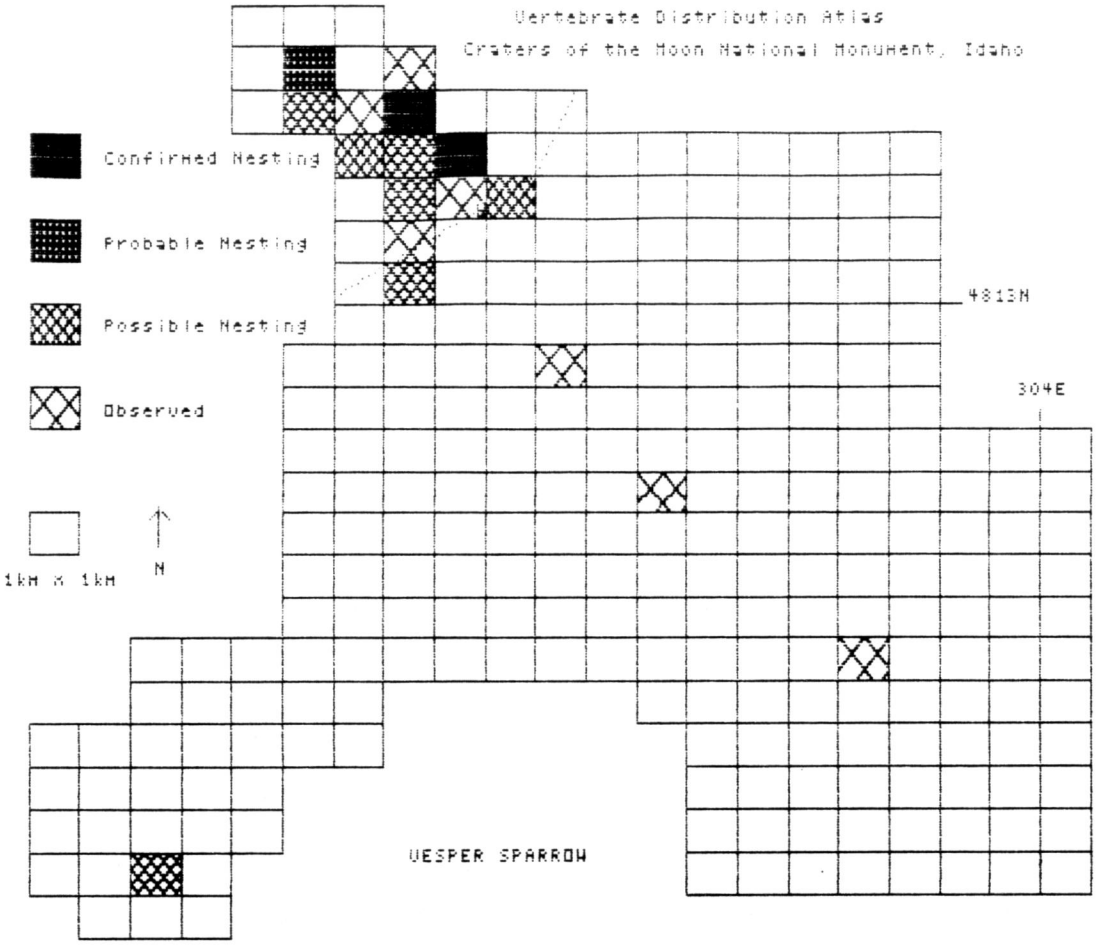

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
LAZULI BUNTING

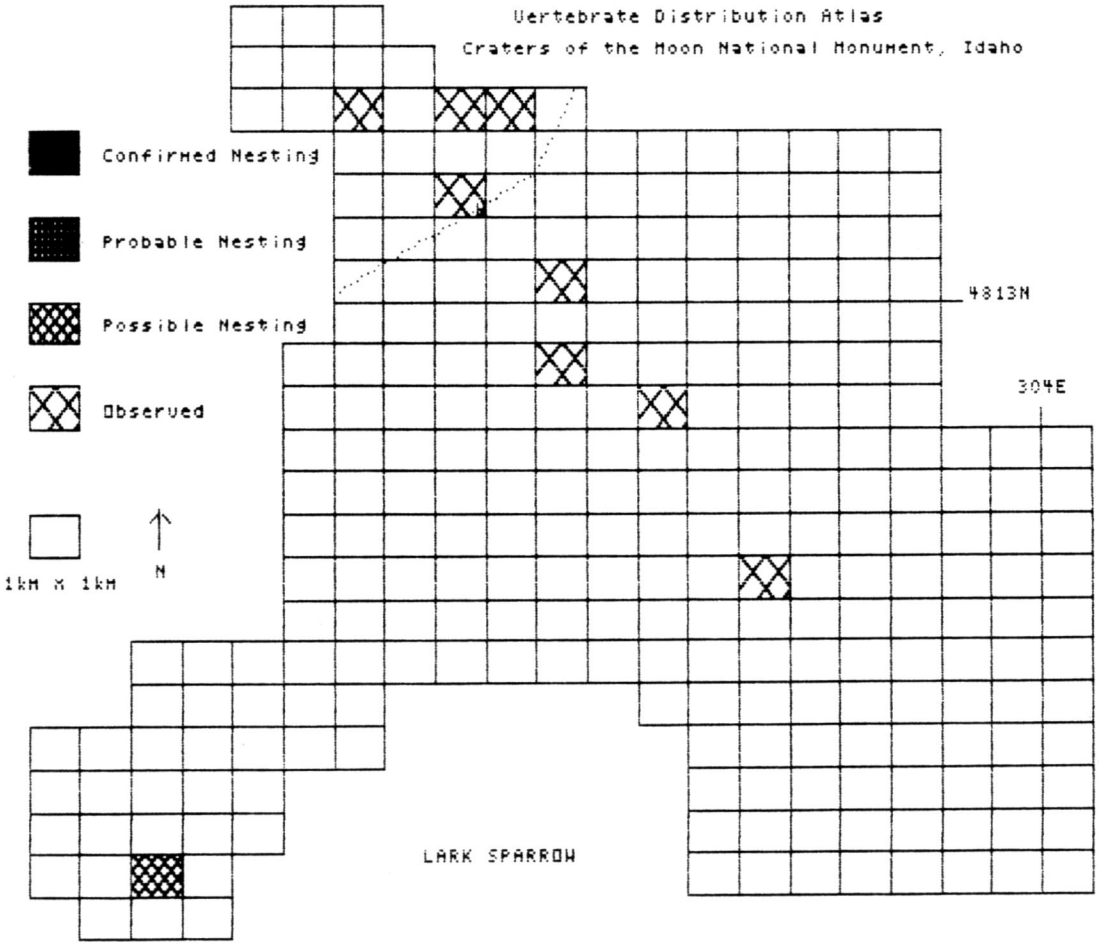

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
GREEN-TAILED TOWHEE

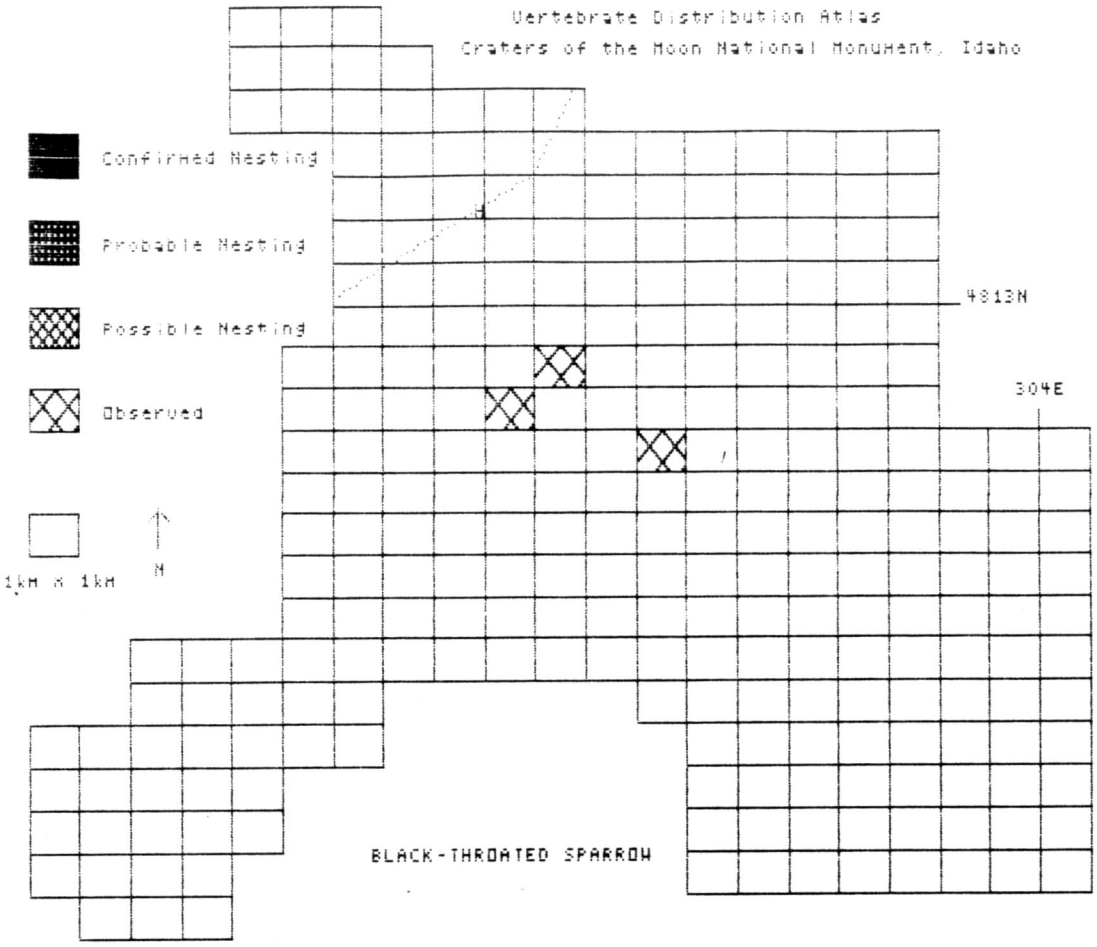

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
RUFOUS-SIDED TOWHEE

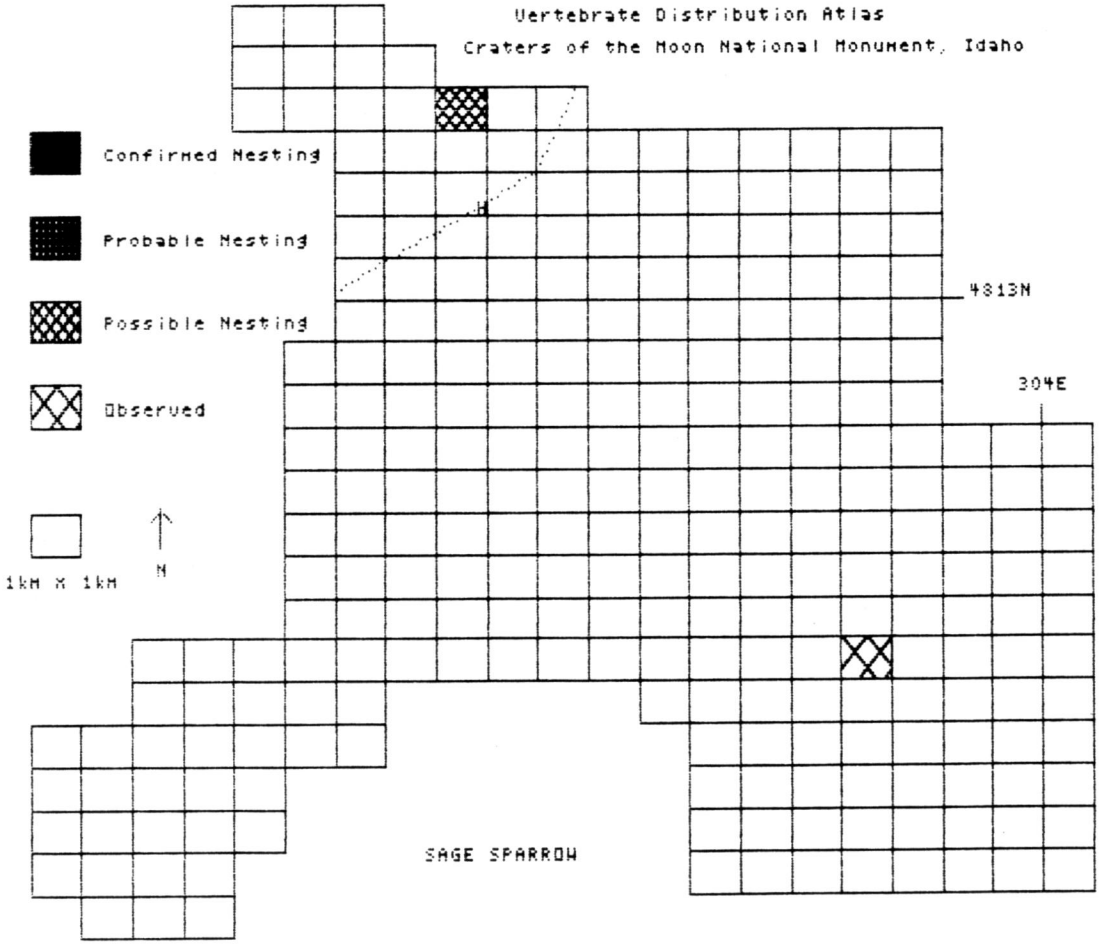

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
CHIPPING SPARROW

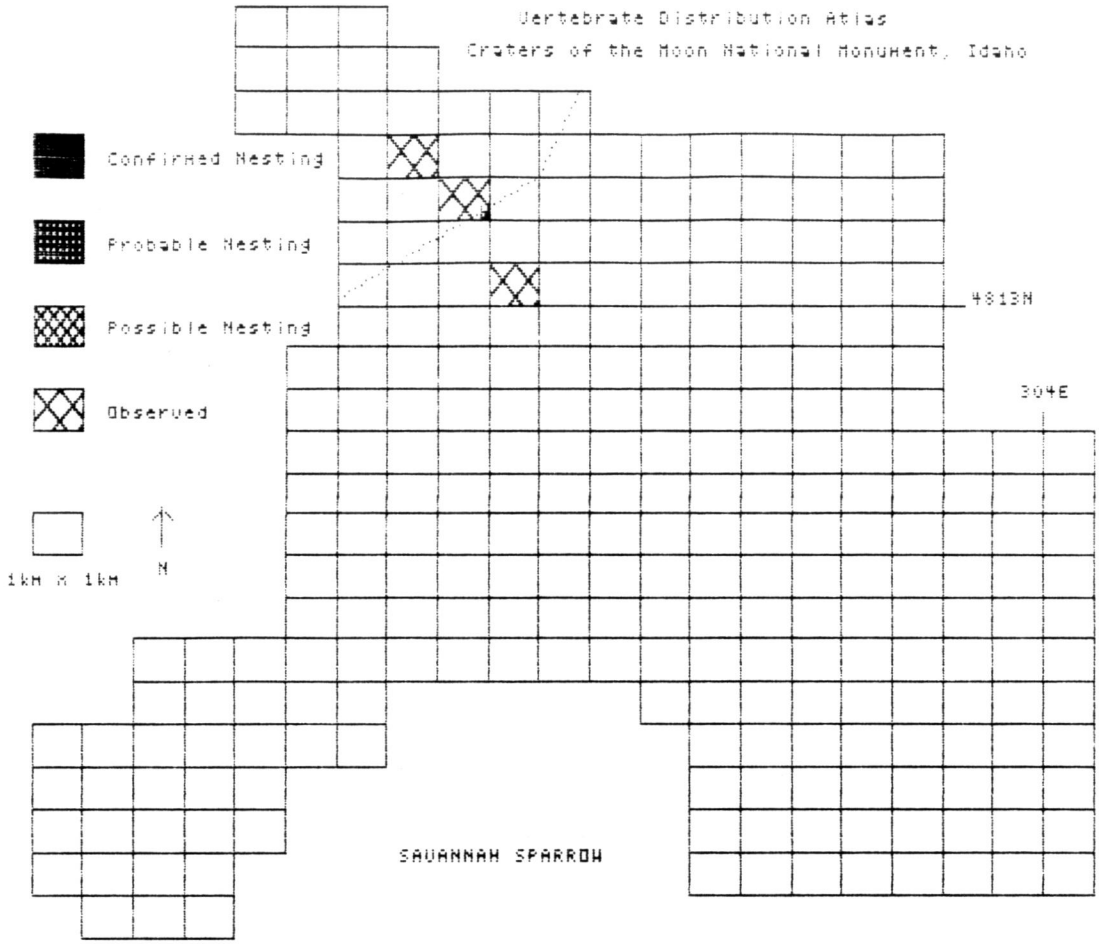

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
BREWER'S SPARROW

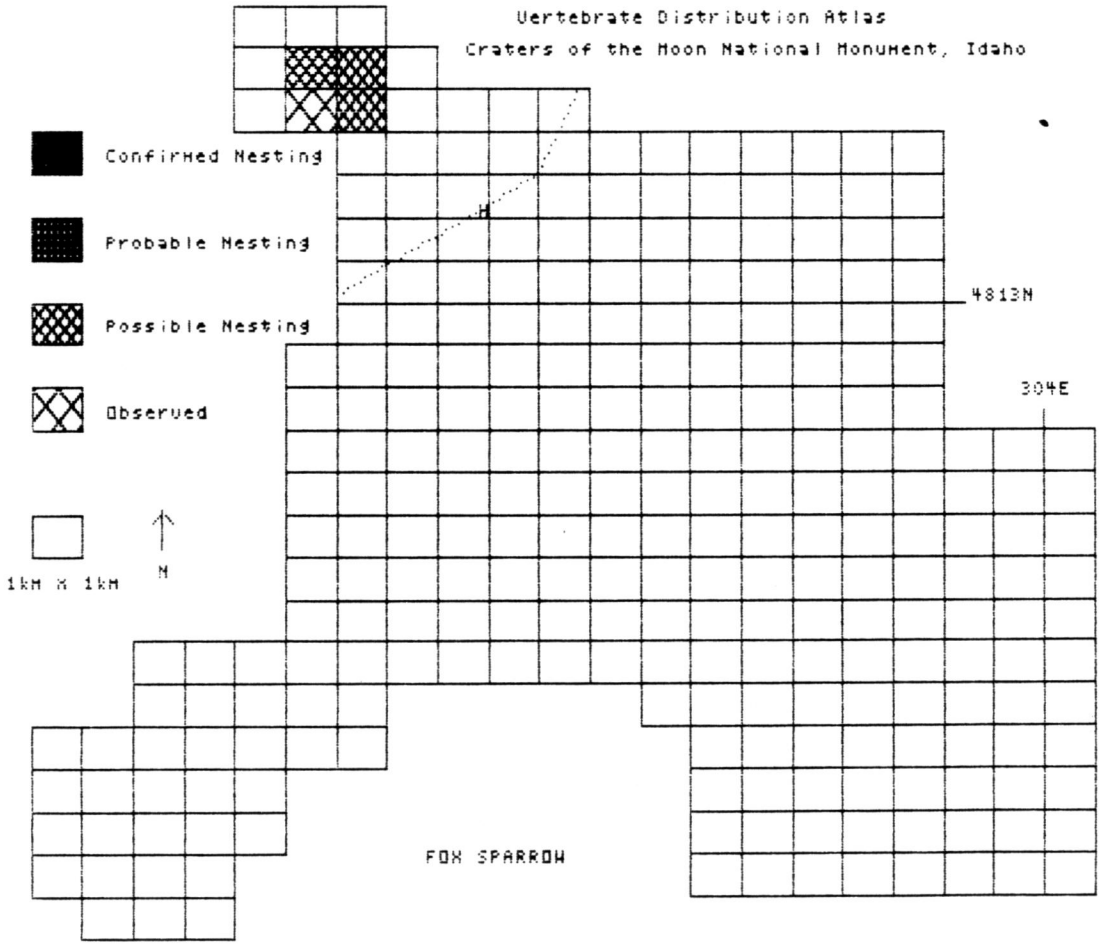

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
VESPER SPARROW

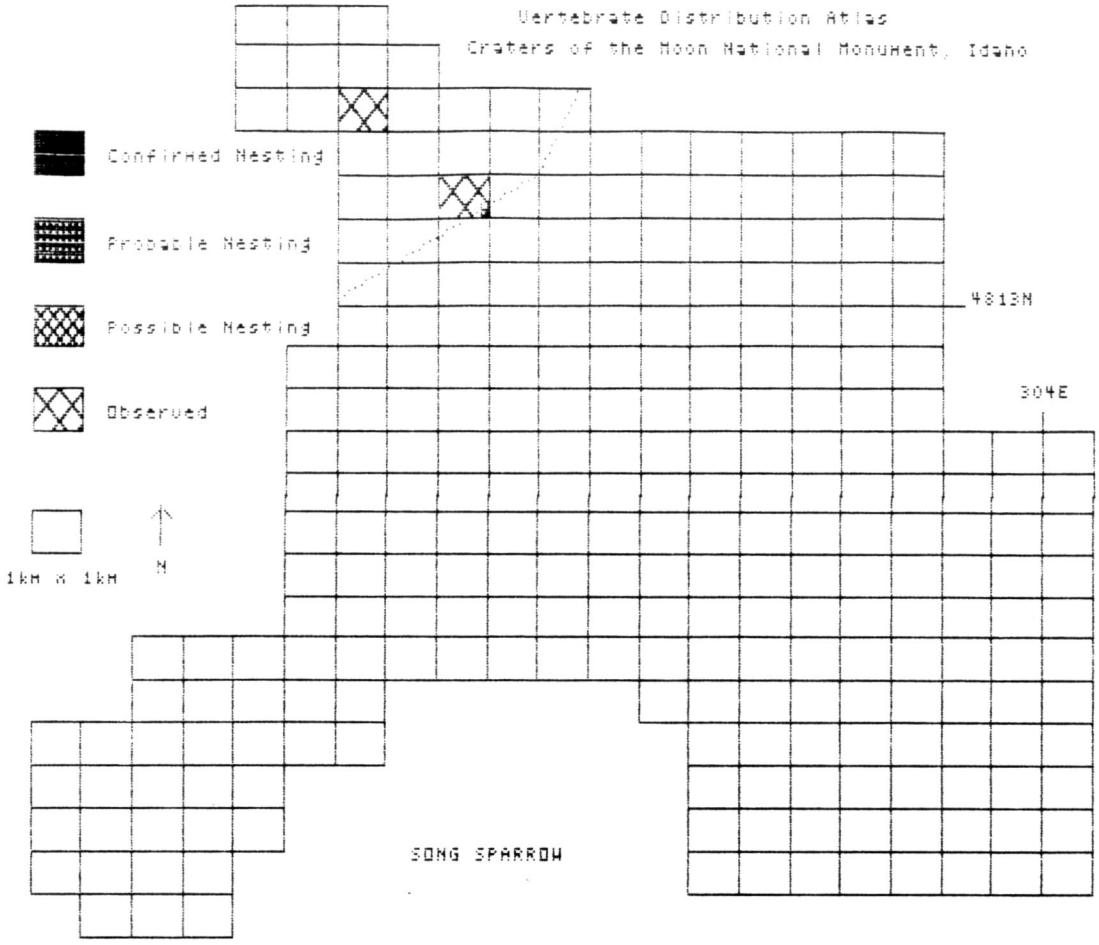

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
LARK SPARROW

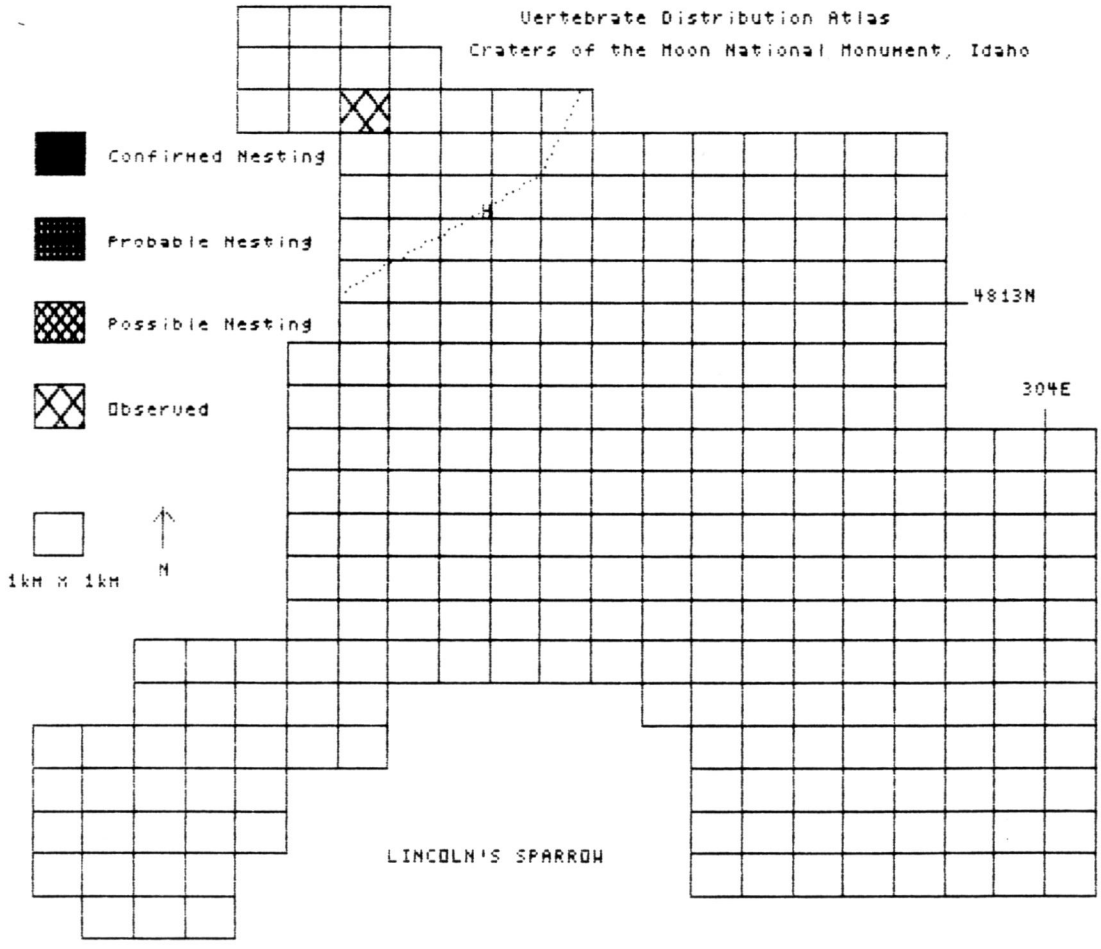

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1kM x 1kM
N
BLACK-THROATED SPARROW

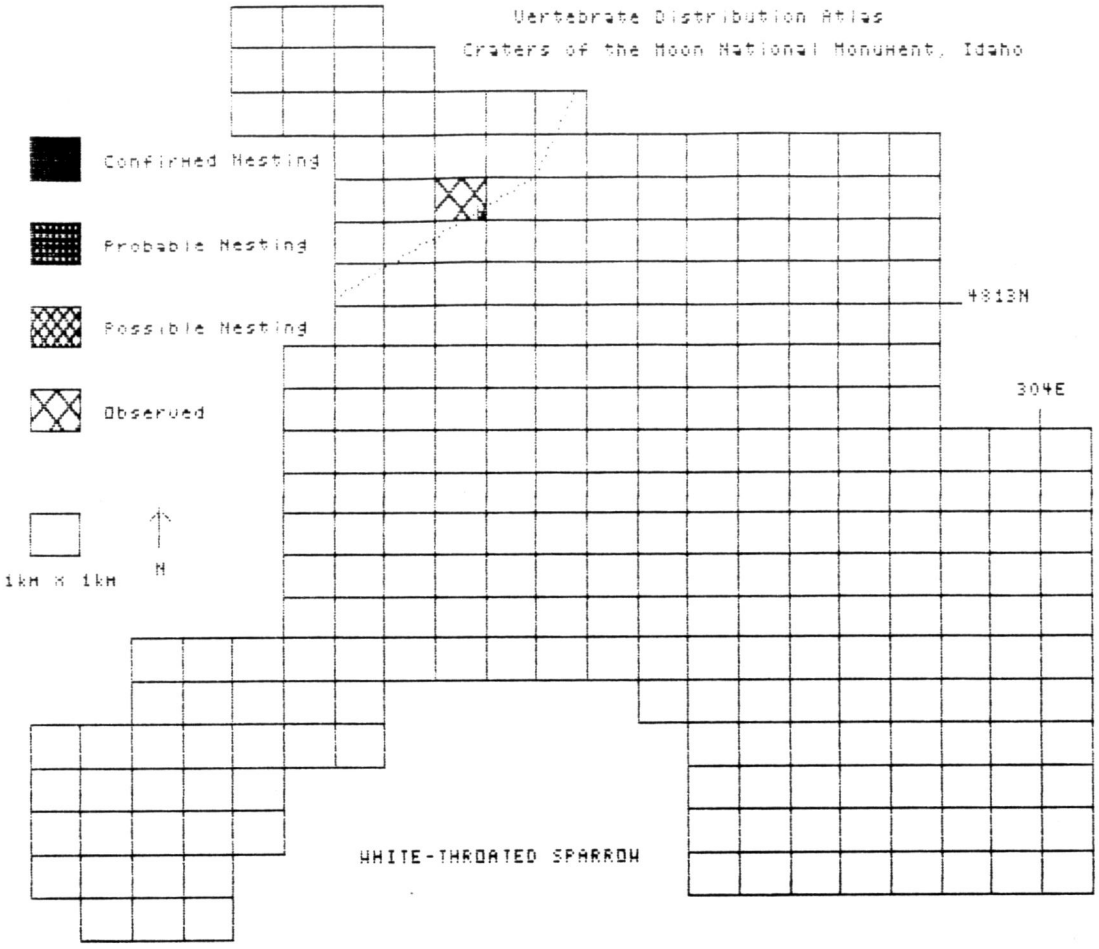

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1kM x 1kM
N
SAGE SPARROW

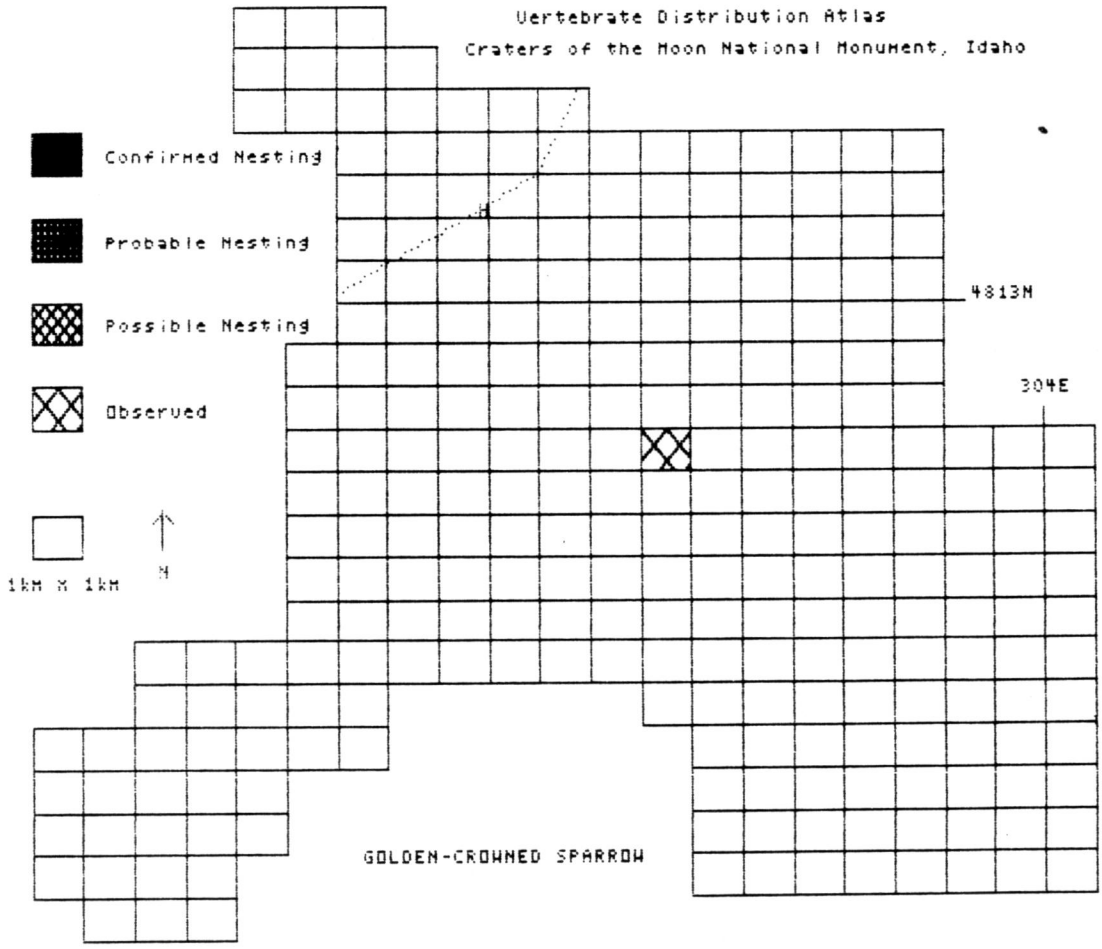

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
SAVANNAH SPARROW

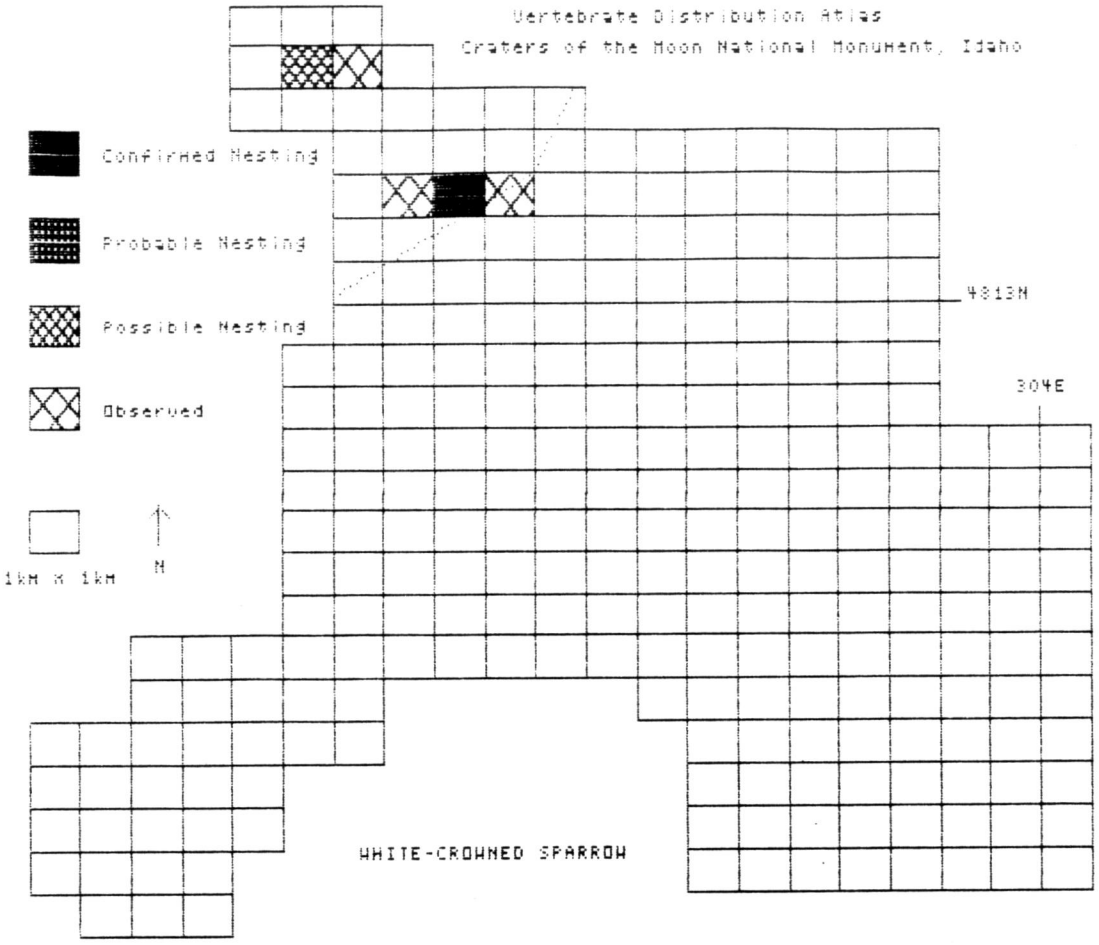

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
FOX SPARROW

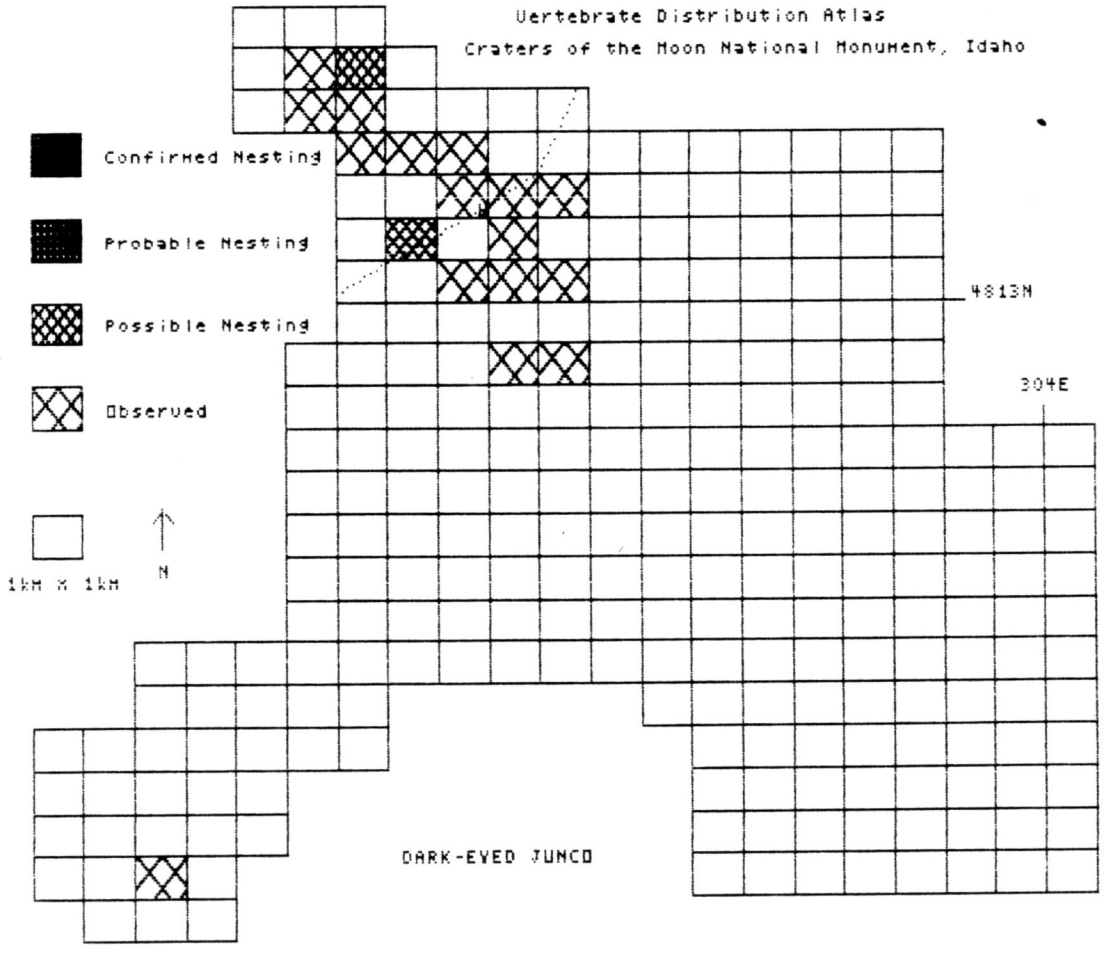

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1km x 1km
N
SONG SPARROW

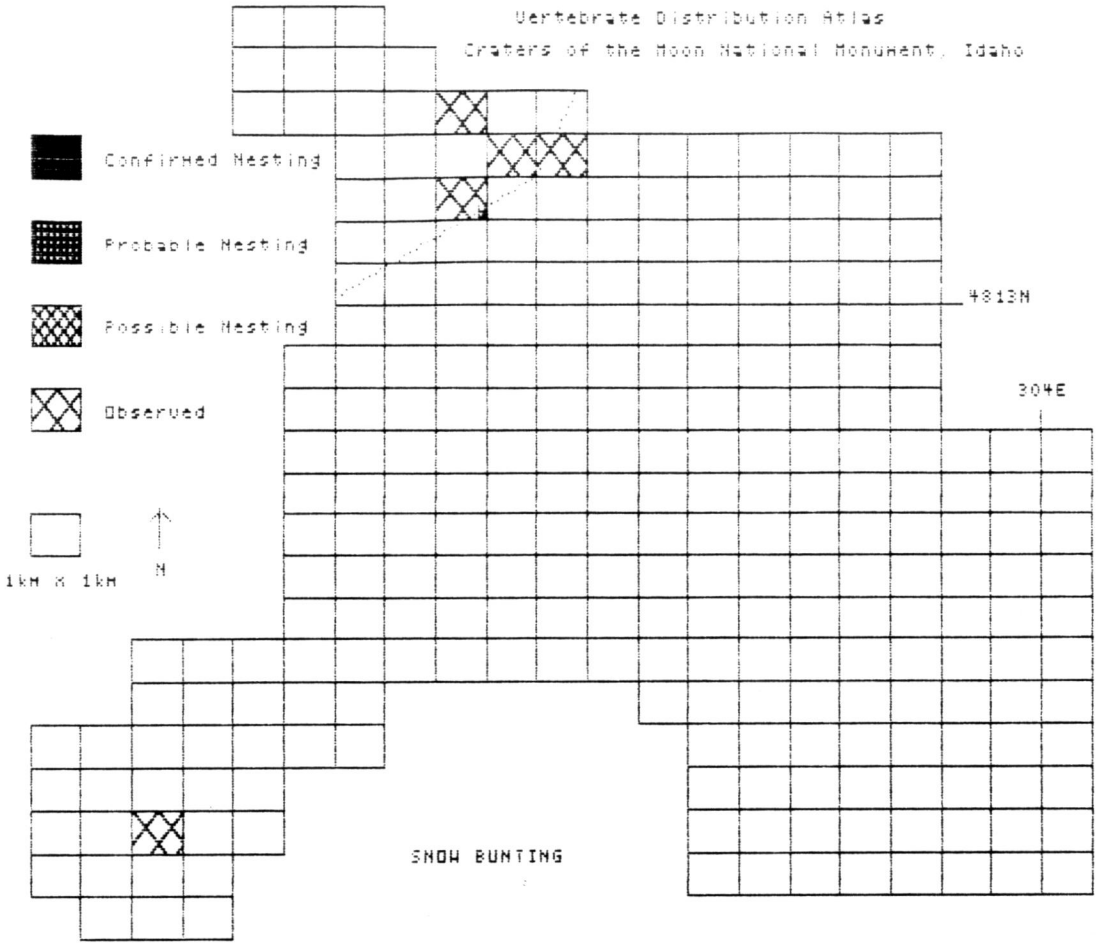

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1km x 1km
N
LINCOLN'S SPARROW

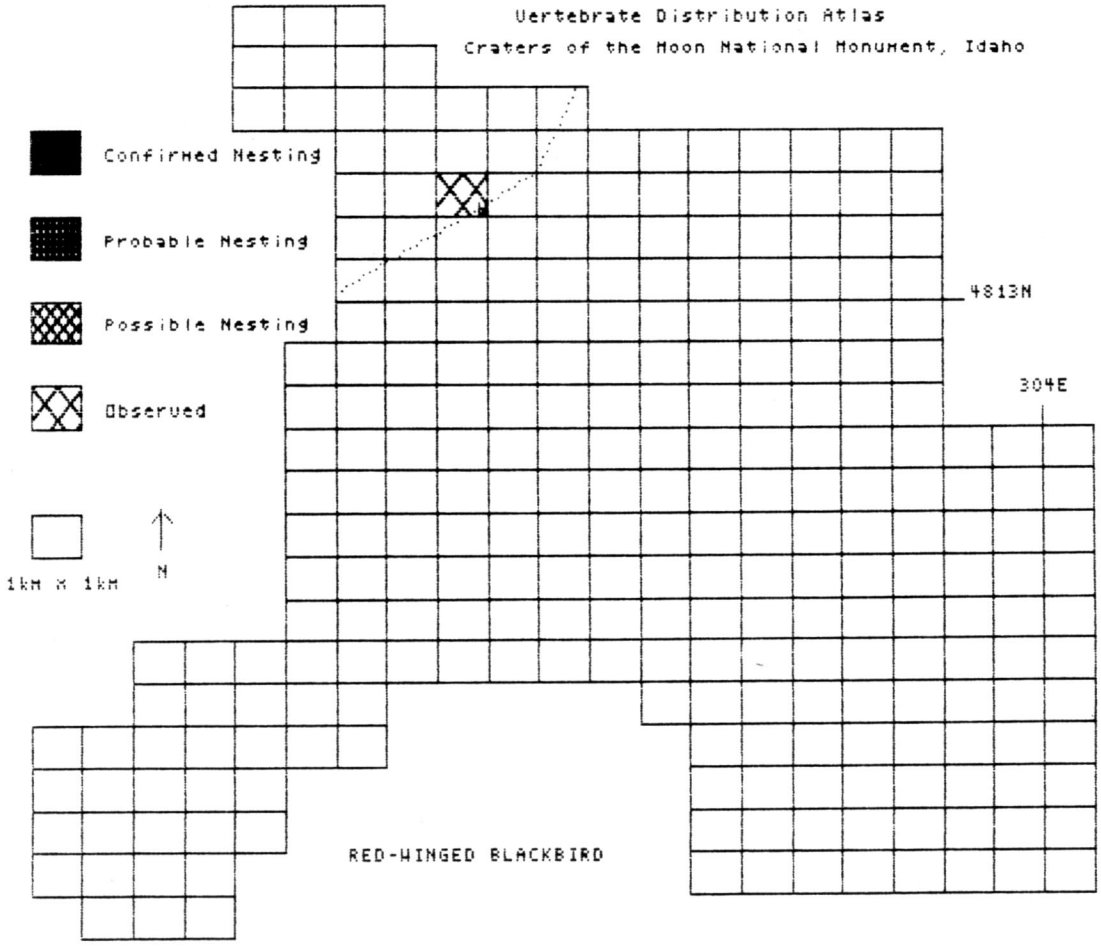

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
WHITE-THROATED SPARROW

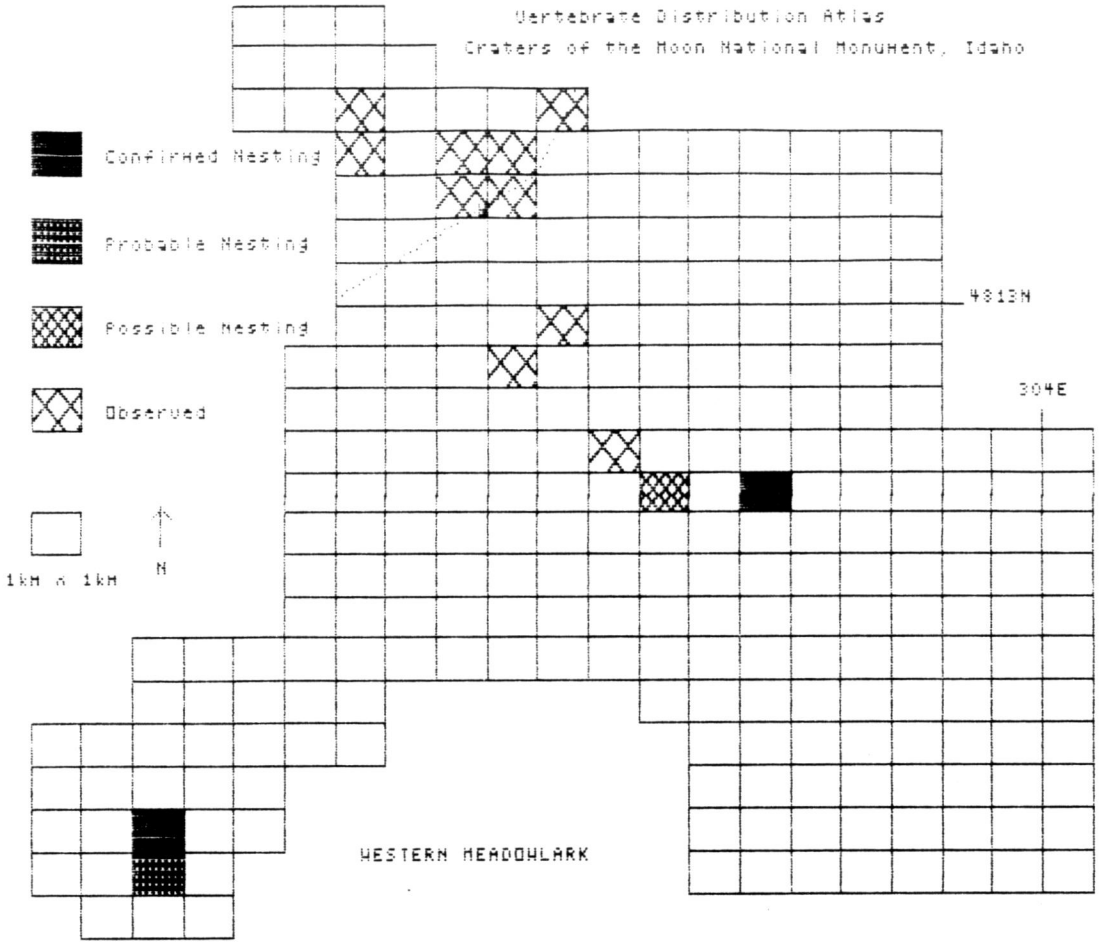

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
GOLDEN-CROWNED SPARROW

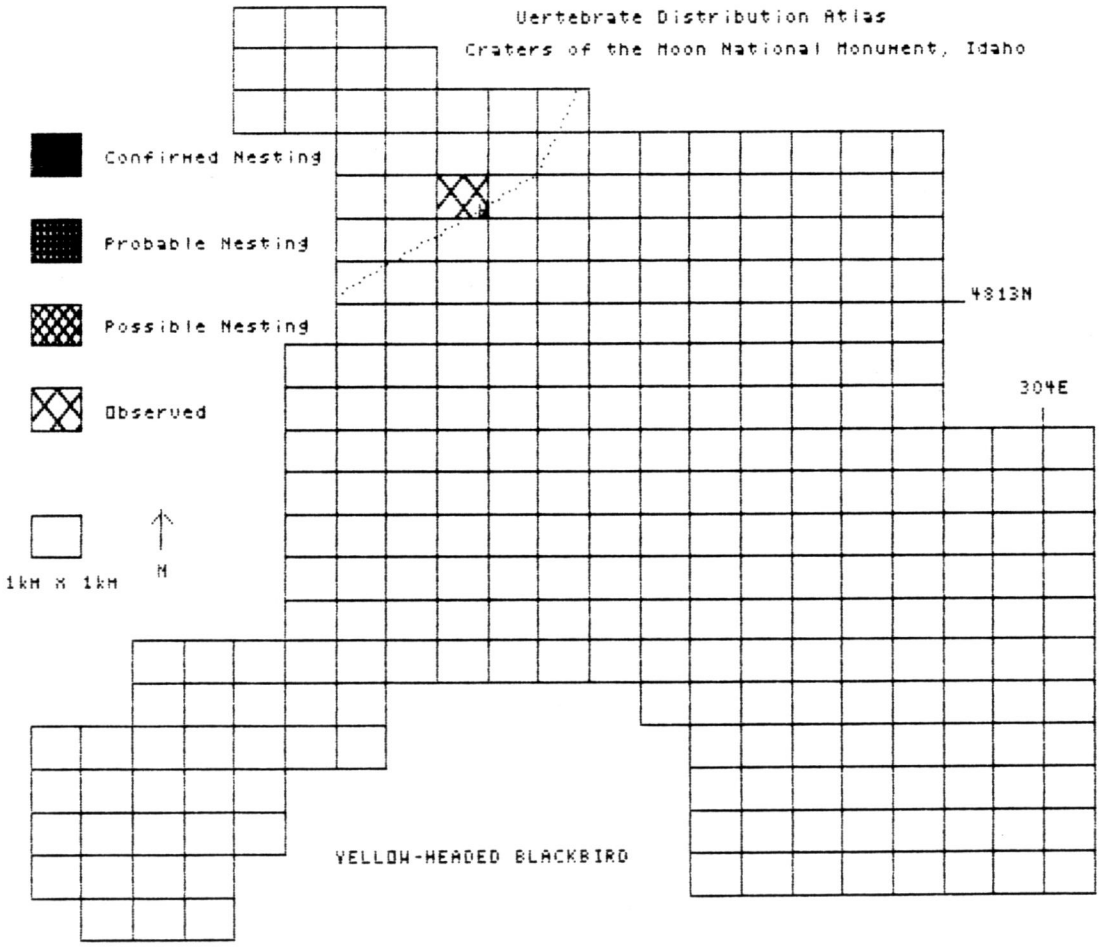

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
WHITE-CROWNED SPARROW

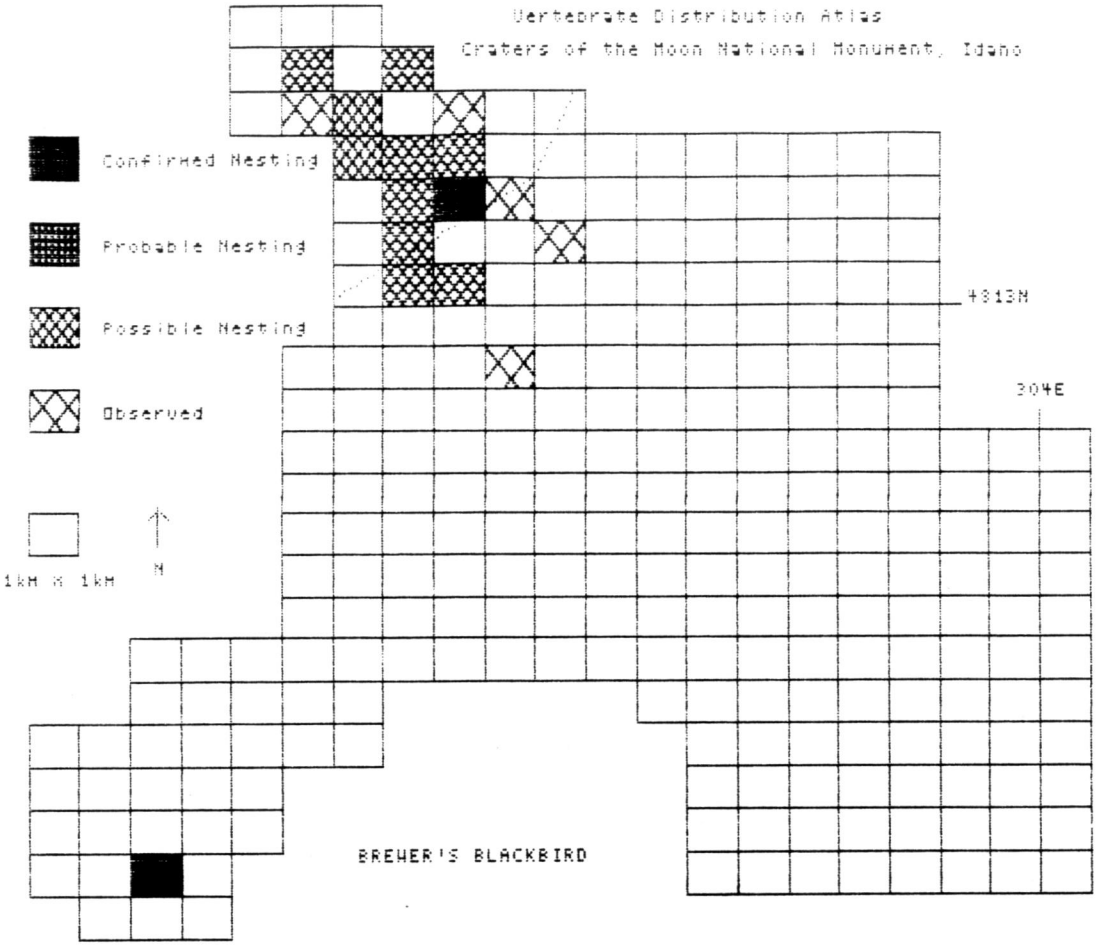

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
DARK-EYED JUNCO

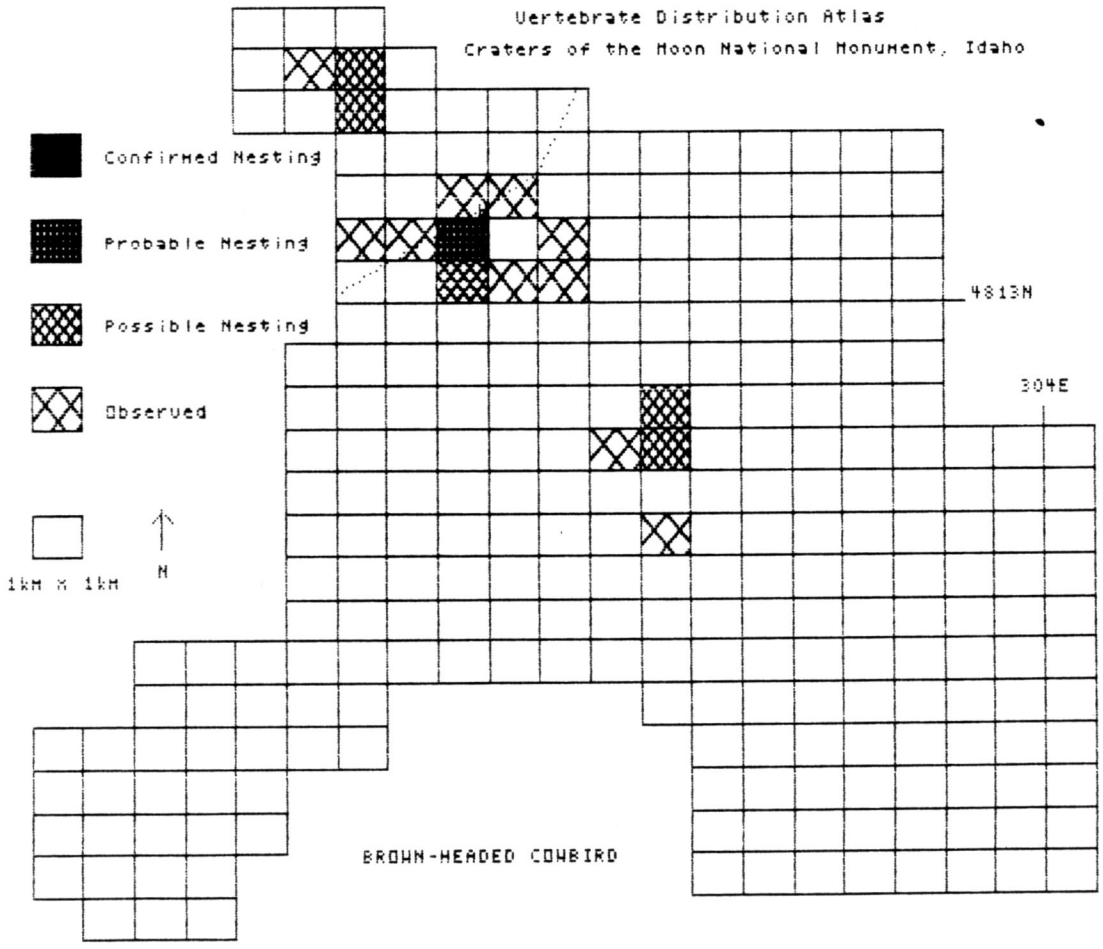

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
SNOW BUNTING

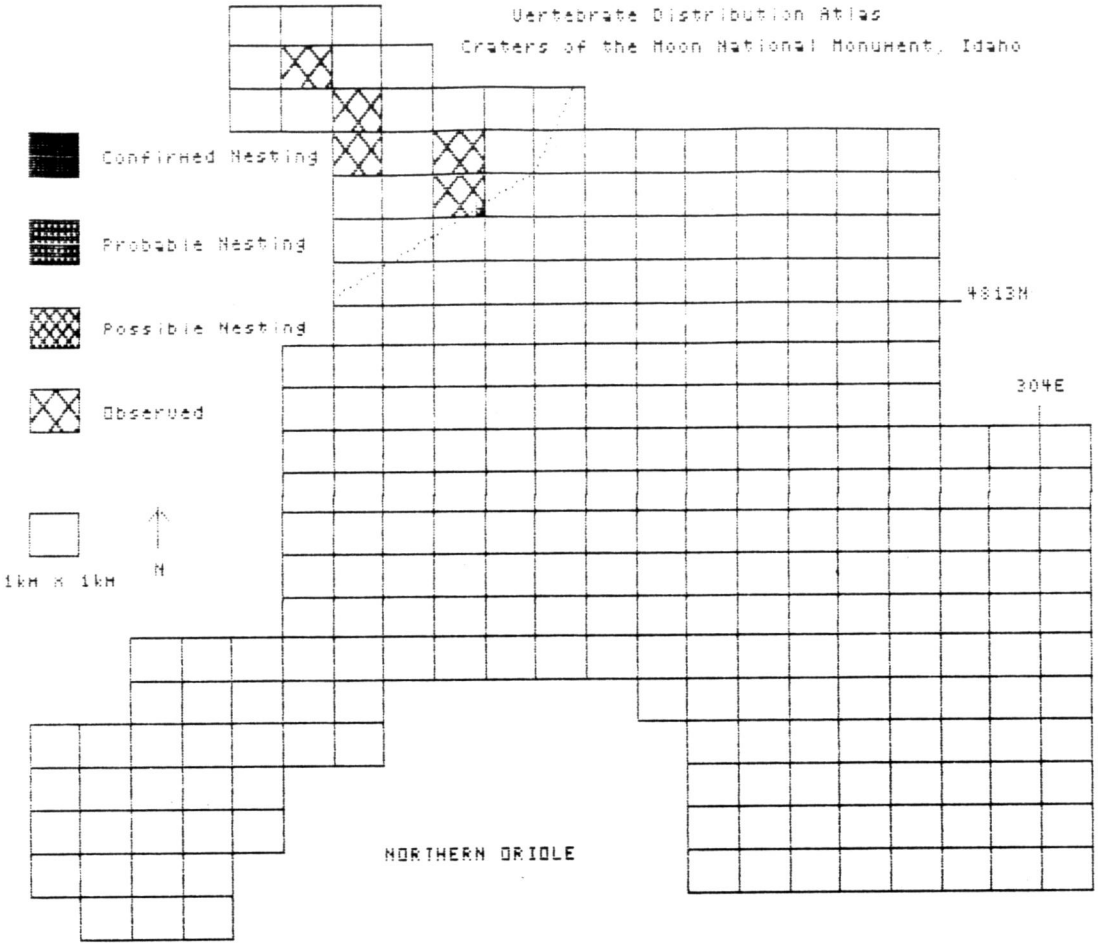

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
RED-WINGED BLACKBIRD

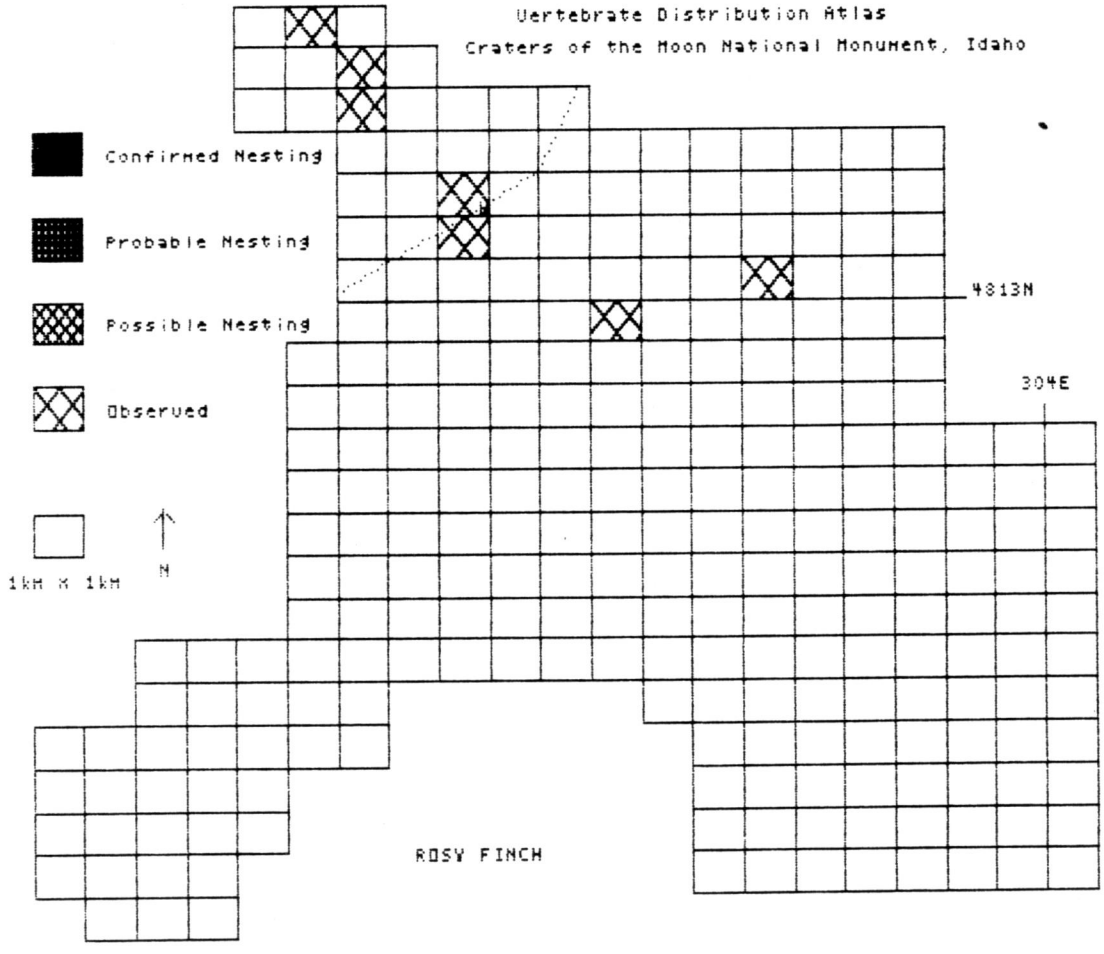

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4913N
304E
WESTERN MEADOWLARK

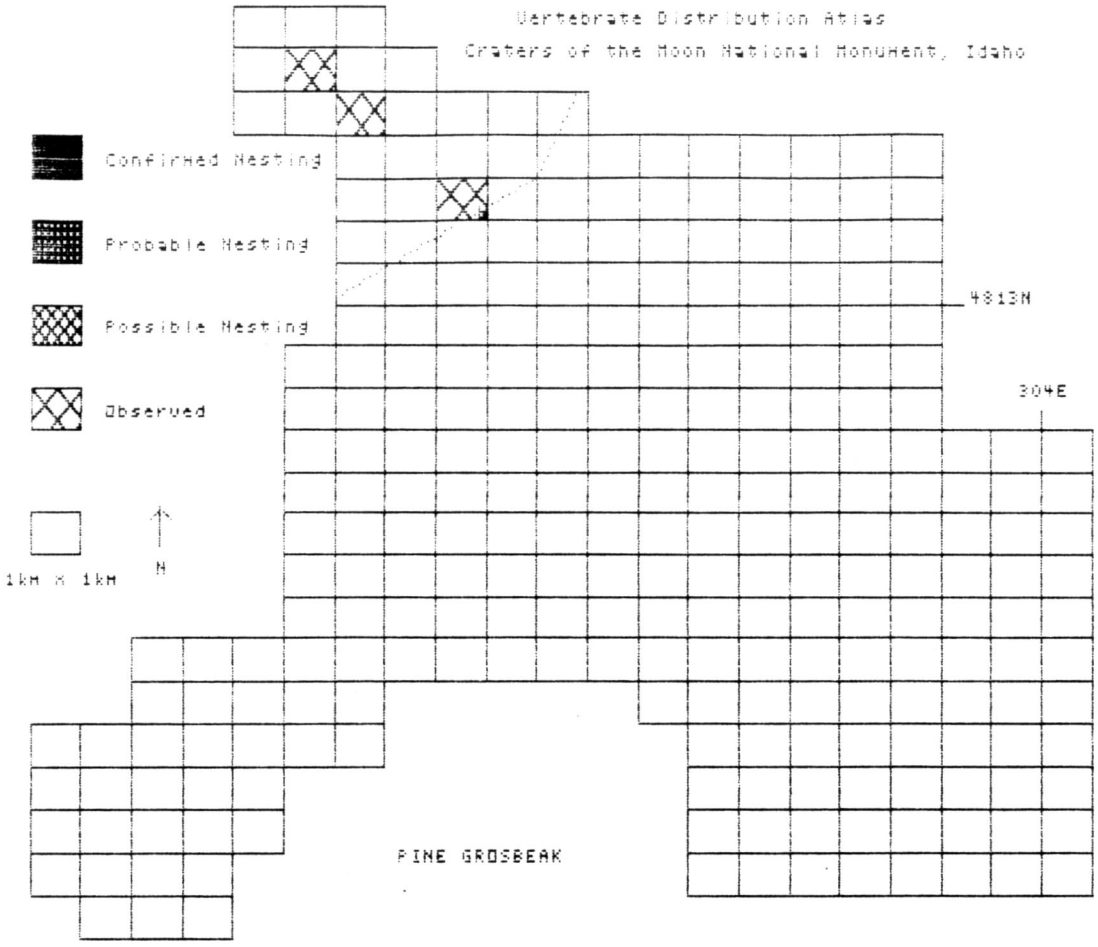

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4913N
304E
YELLOW-HEADED BLACKBIRD

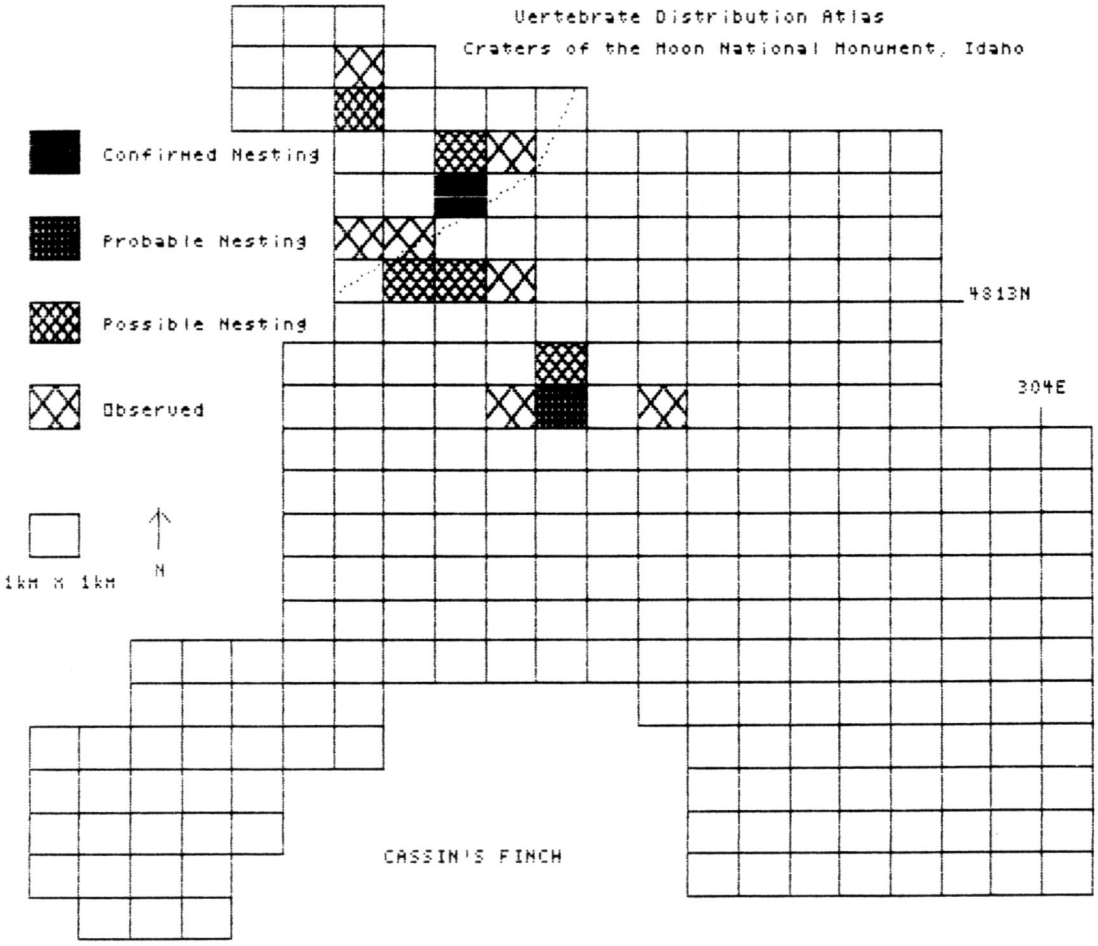

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
BREWER'S BLACKBIRD

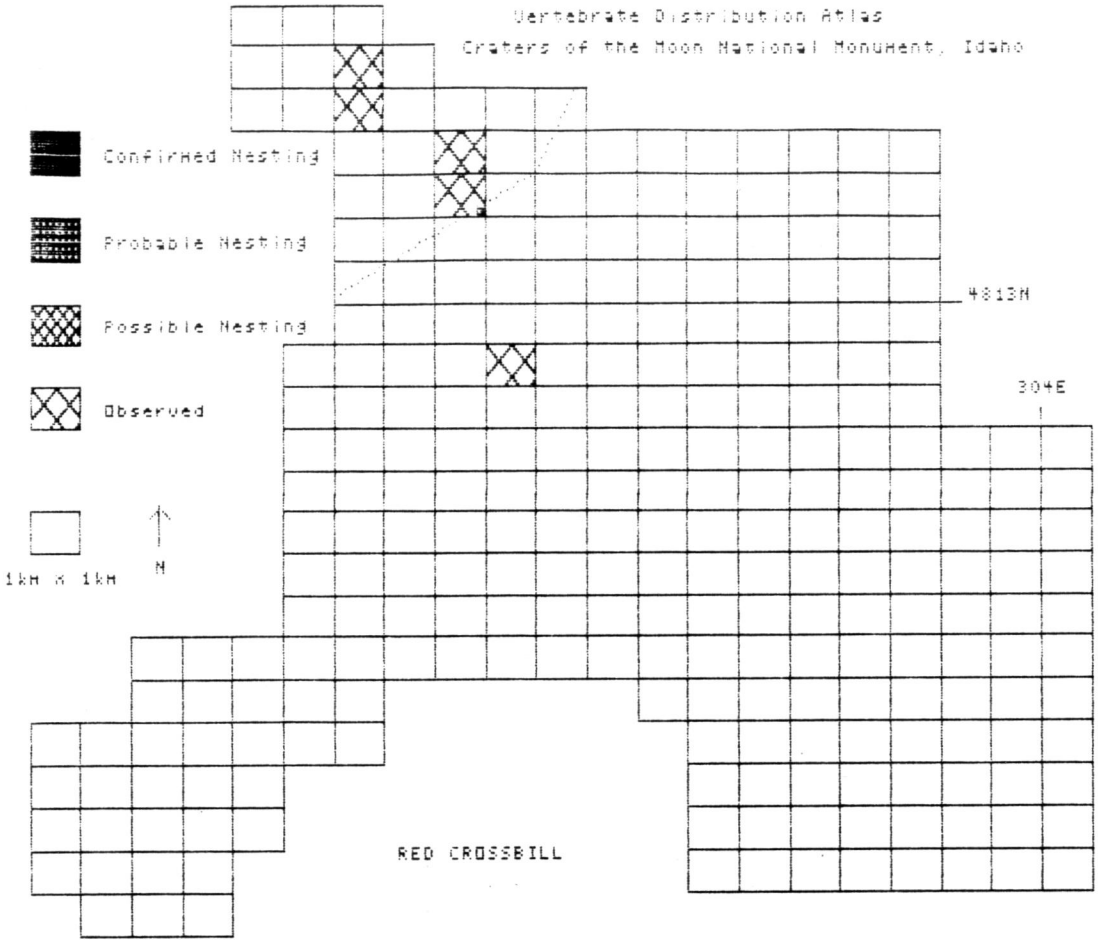

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
BROWN-HEADED COWBIRD

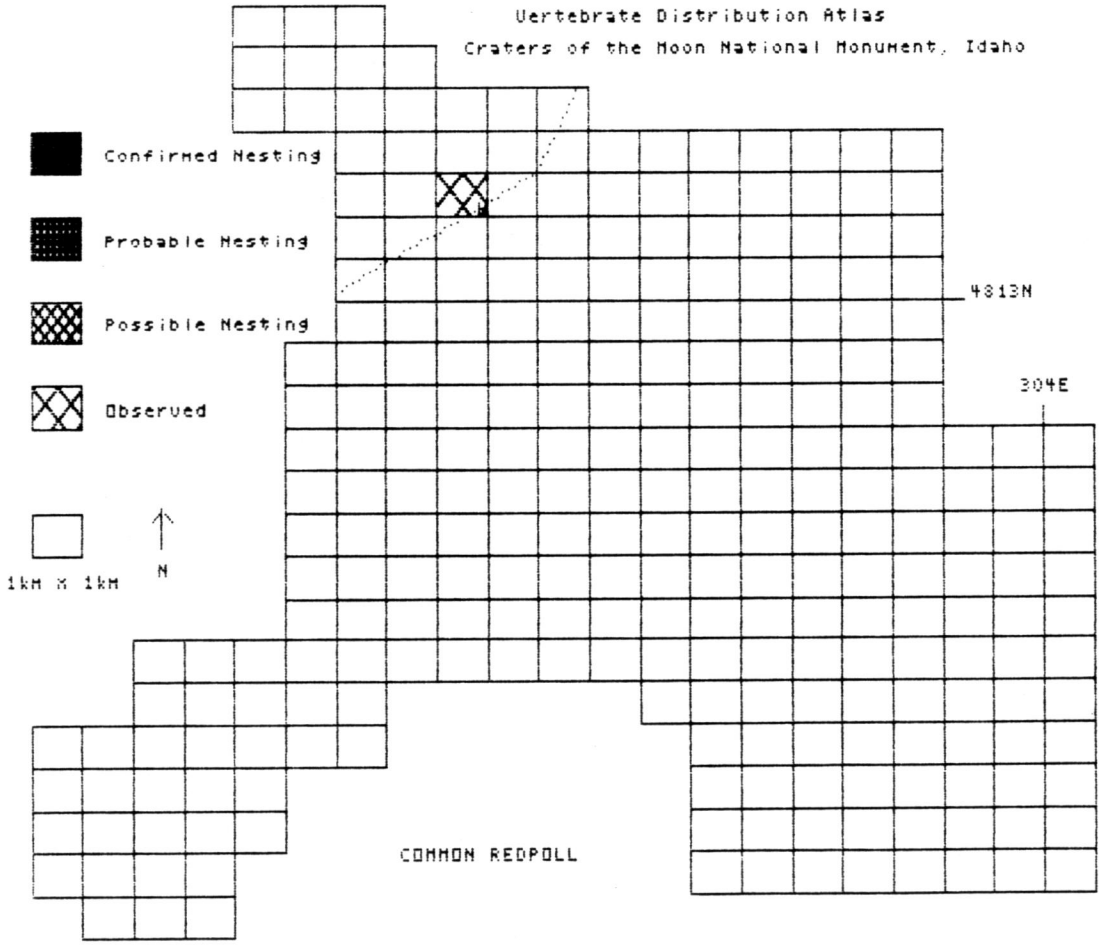

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
NORTHERN ORIOLE

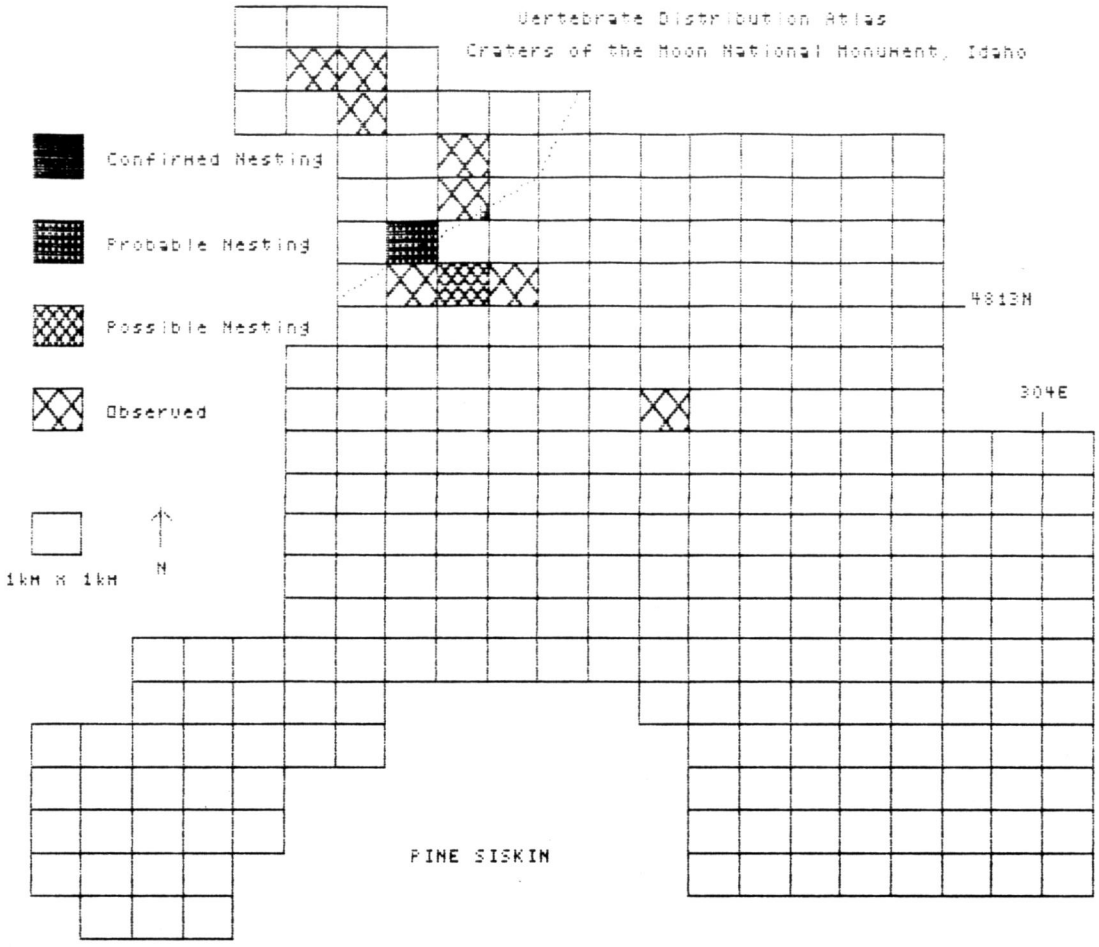

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
ROSY FINCH

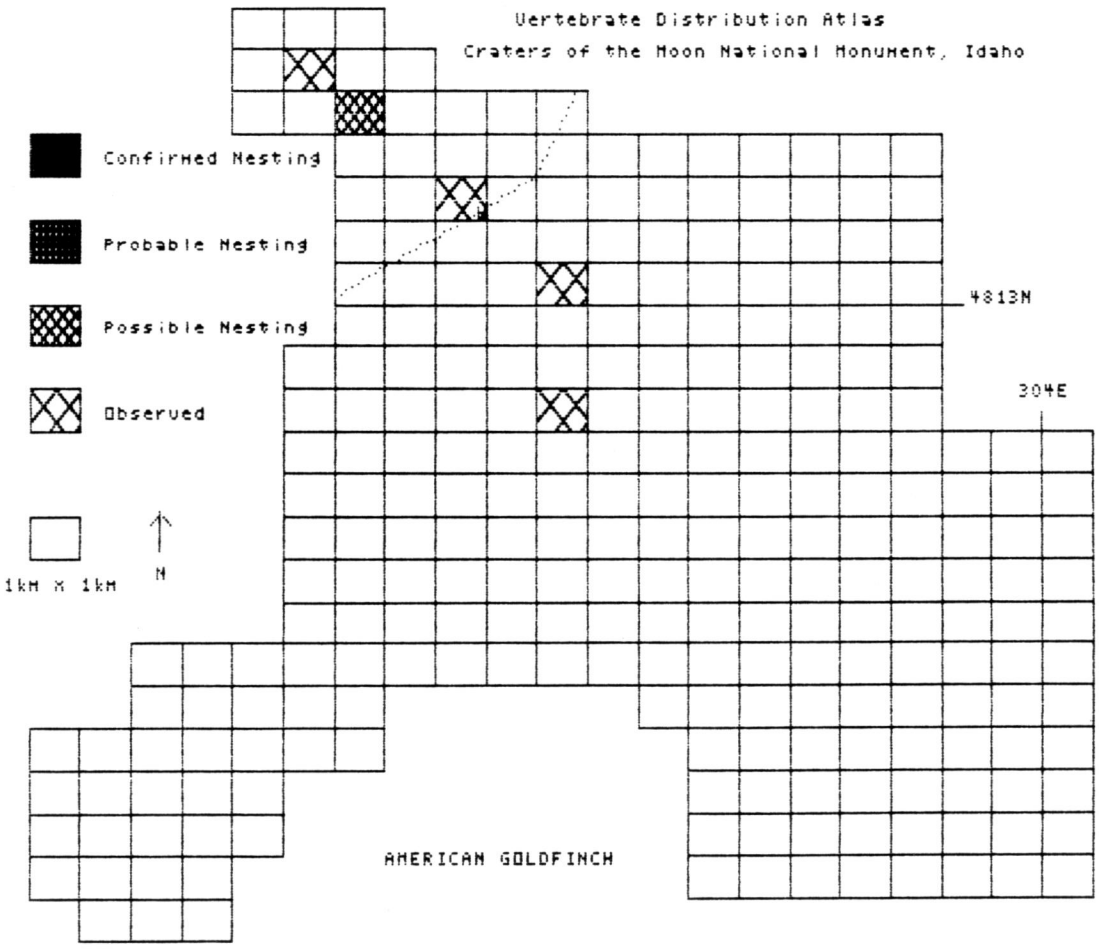

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1km x 1km
N
PINE GROSBEAK

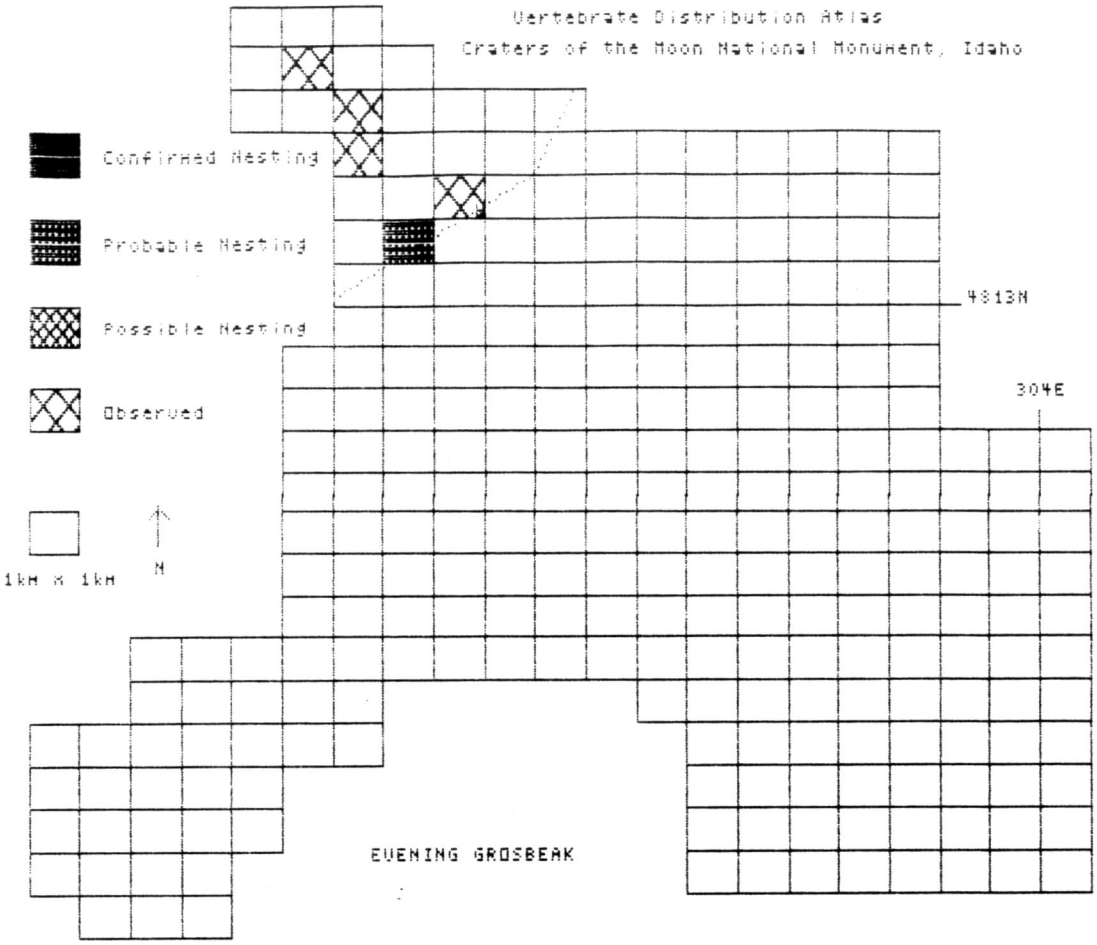

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1km x 1km
N
CASSIN'S FINCH

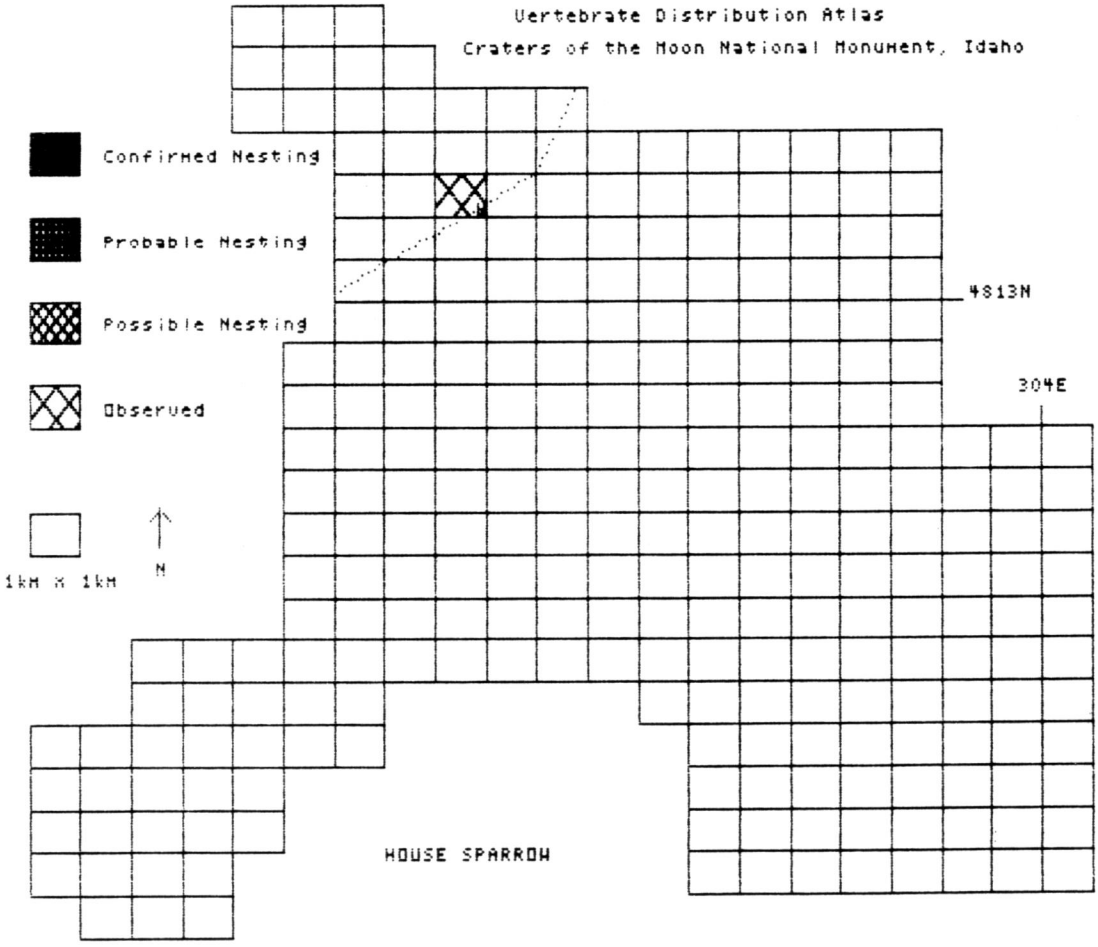

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
RED CROSSBILL

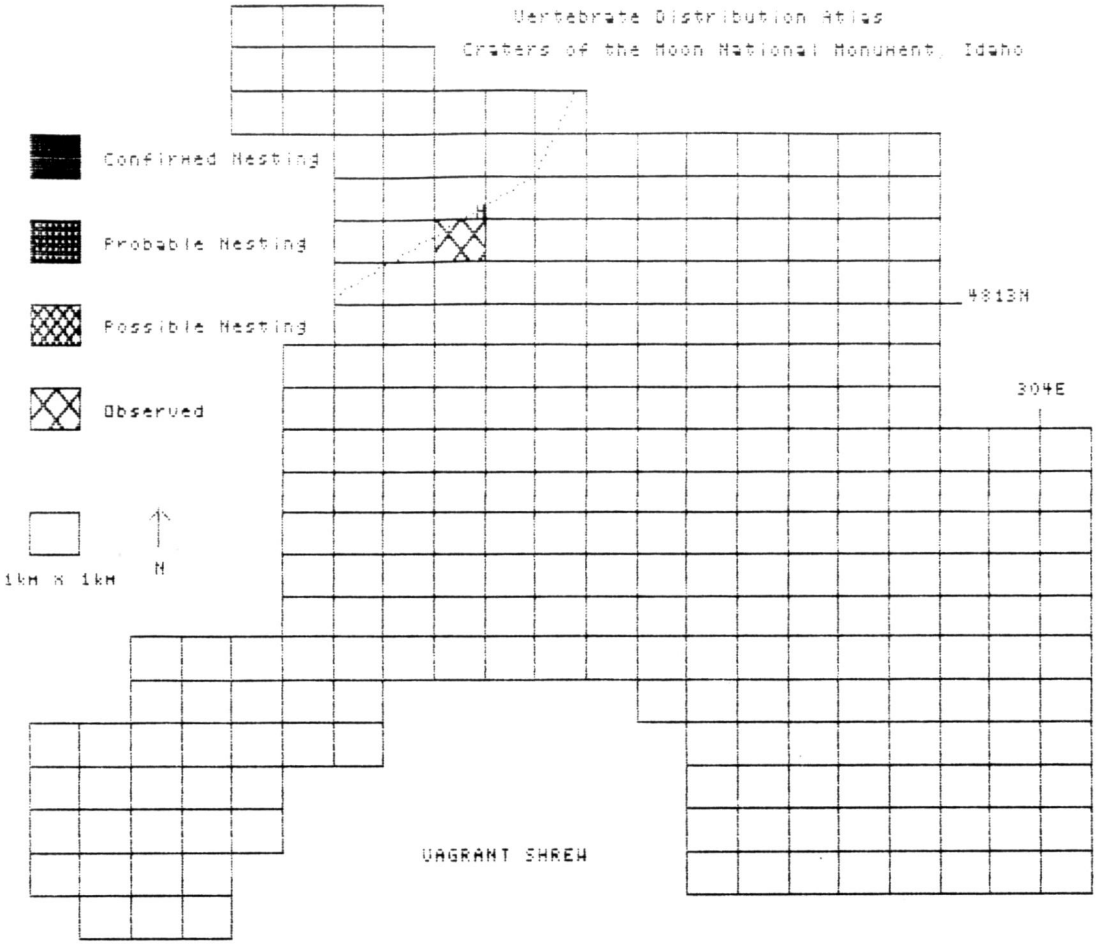

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
COMMON REDPOLL

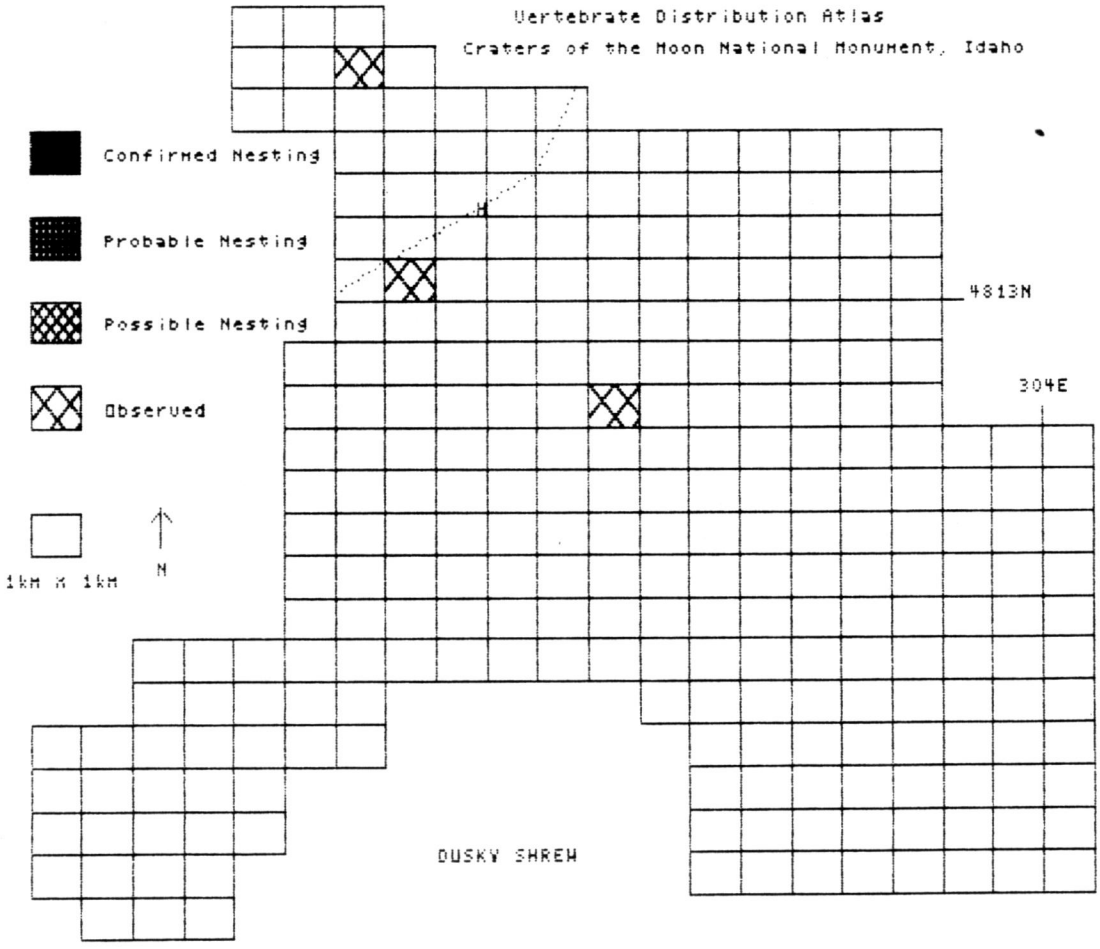

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1km x 1km
N
PINE SISKIN

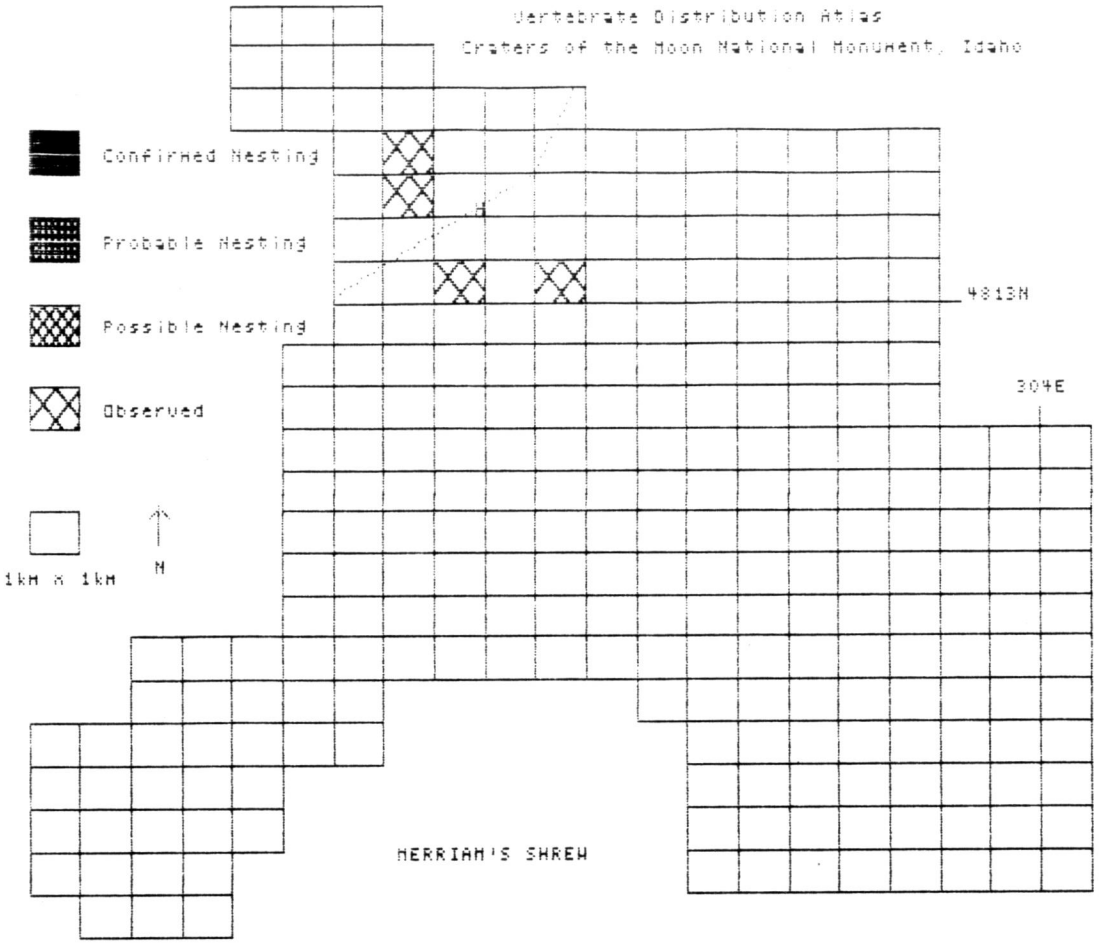

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1km x 1km
N
AMERICAN GOLDFINCH

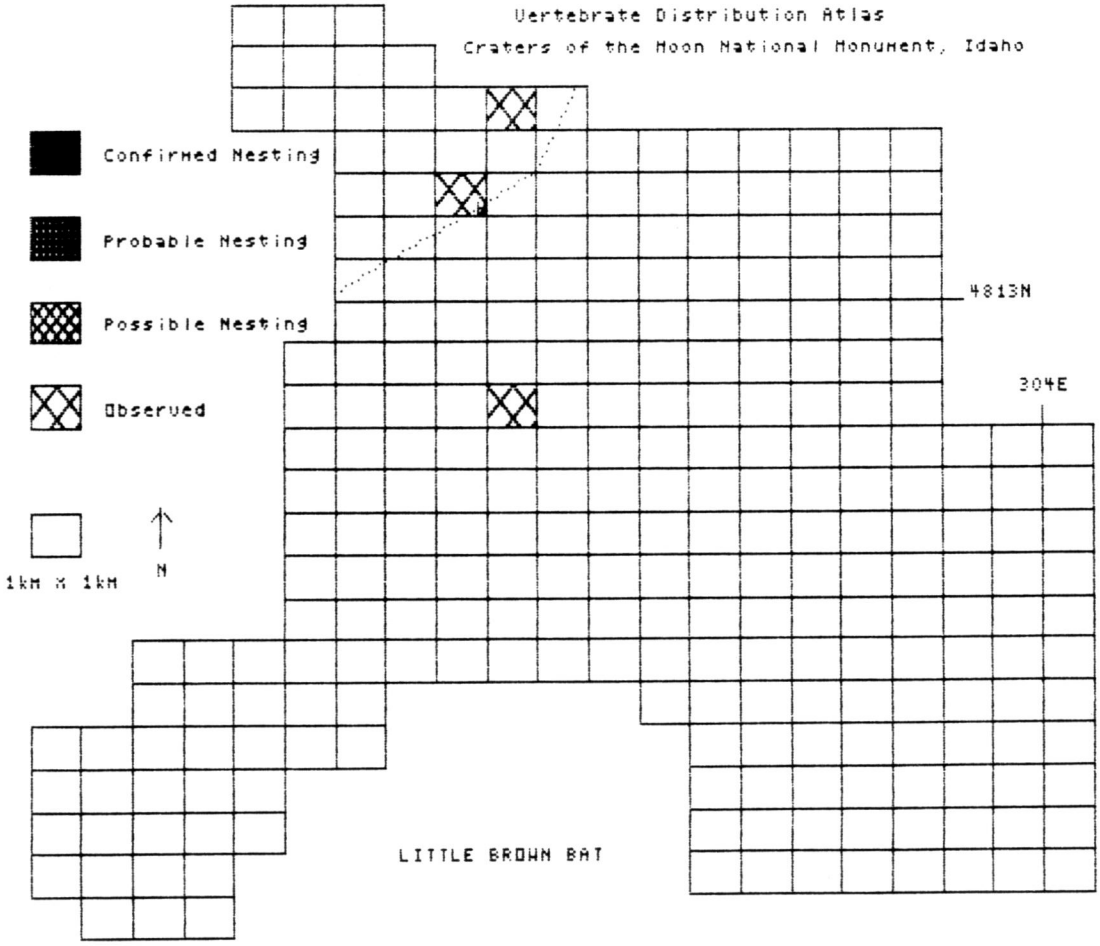

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4S13N
304E
EVENING GROSBEAK

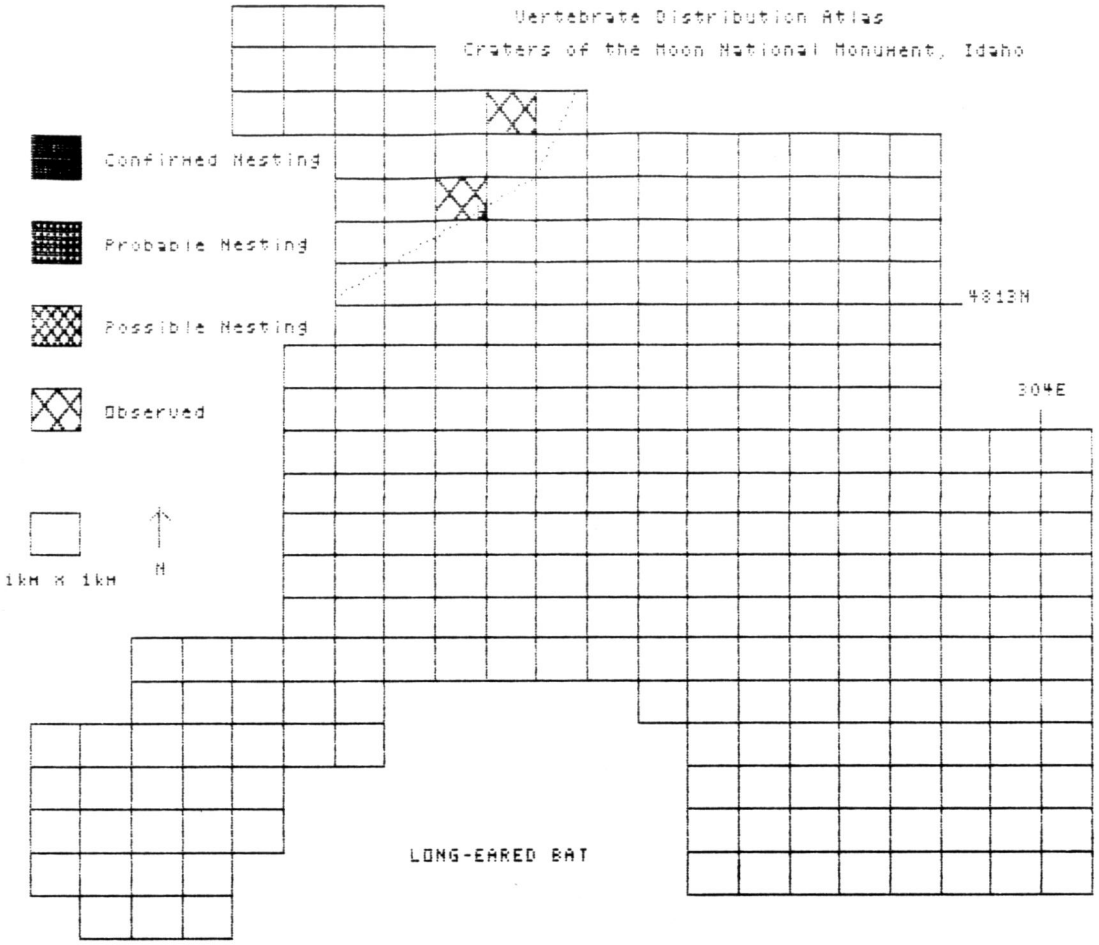

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4S13N
304E
HOUSE SPARROW

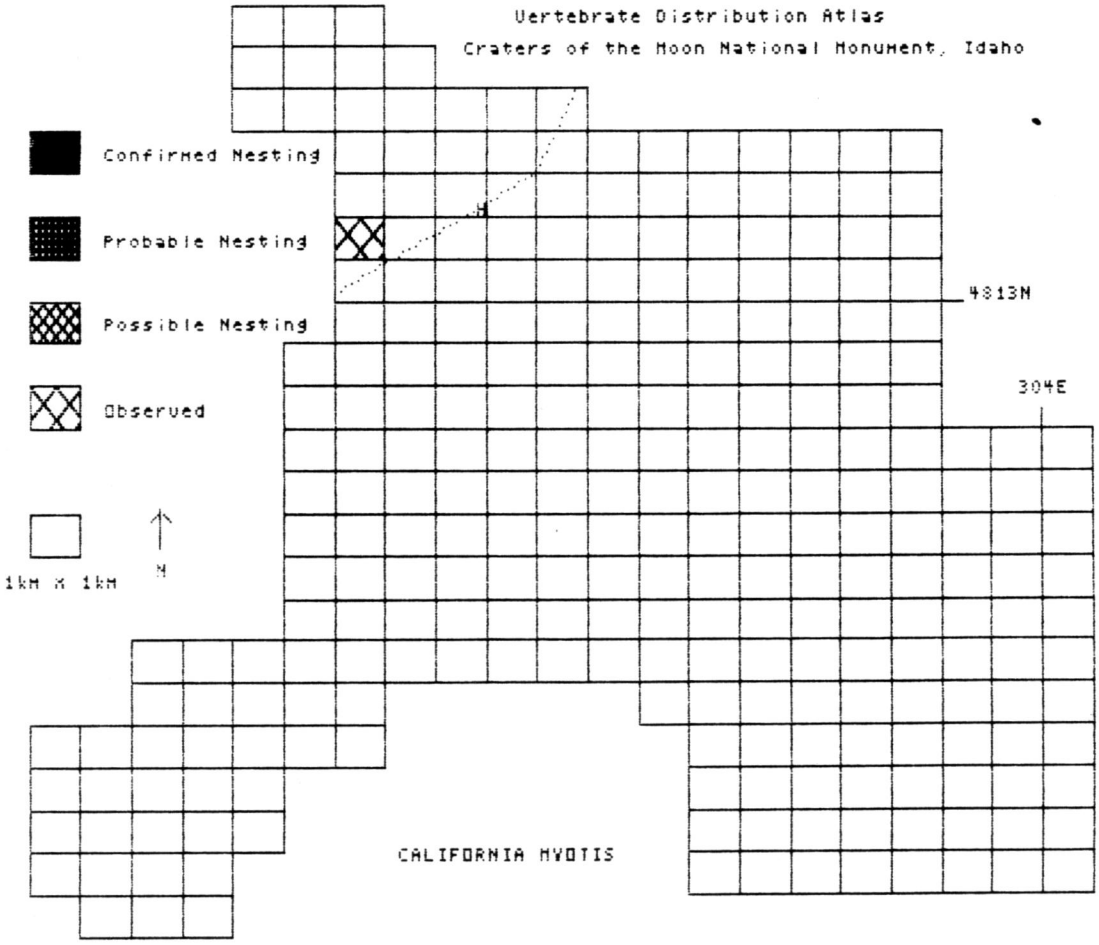

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km X 1km
N
4813N
304E
VAGRANT SHREW

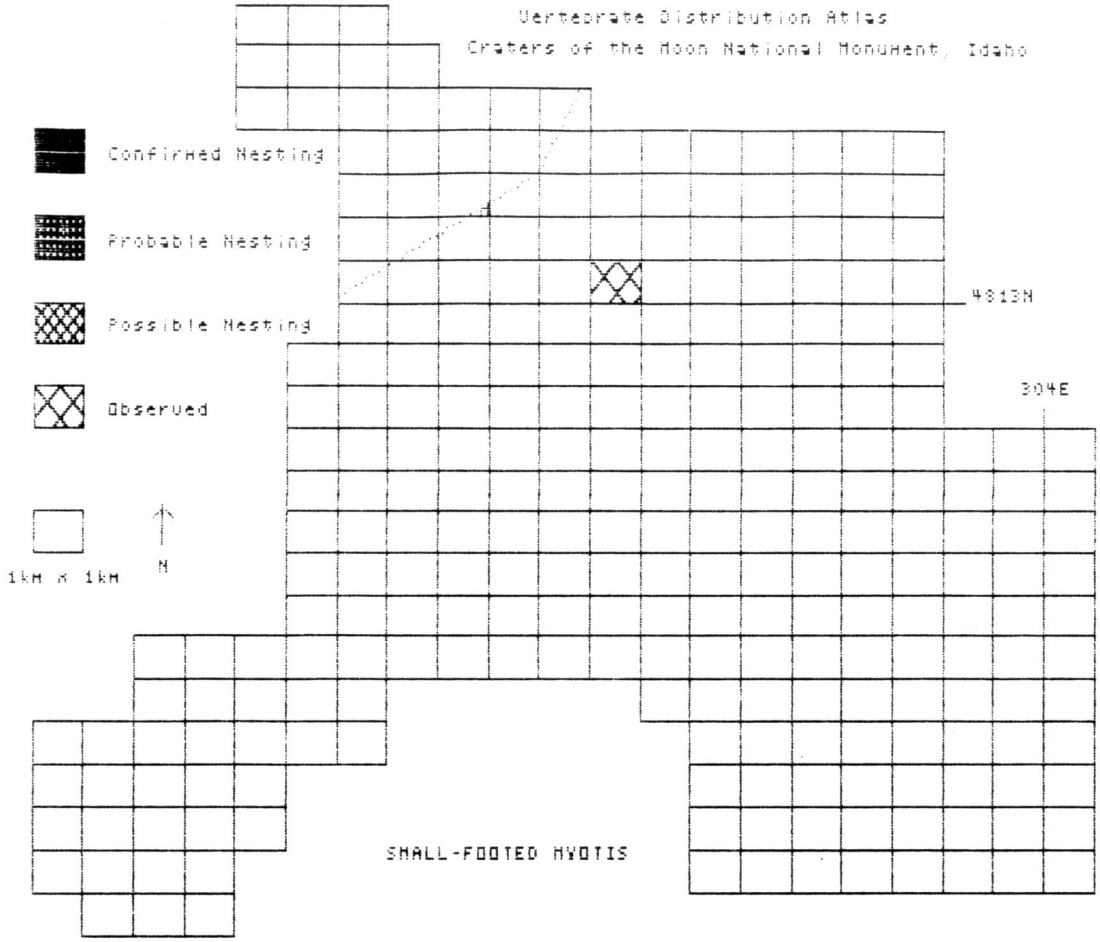

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km X 1km
N
4813N
304E
DUSKY SHREW

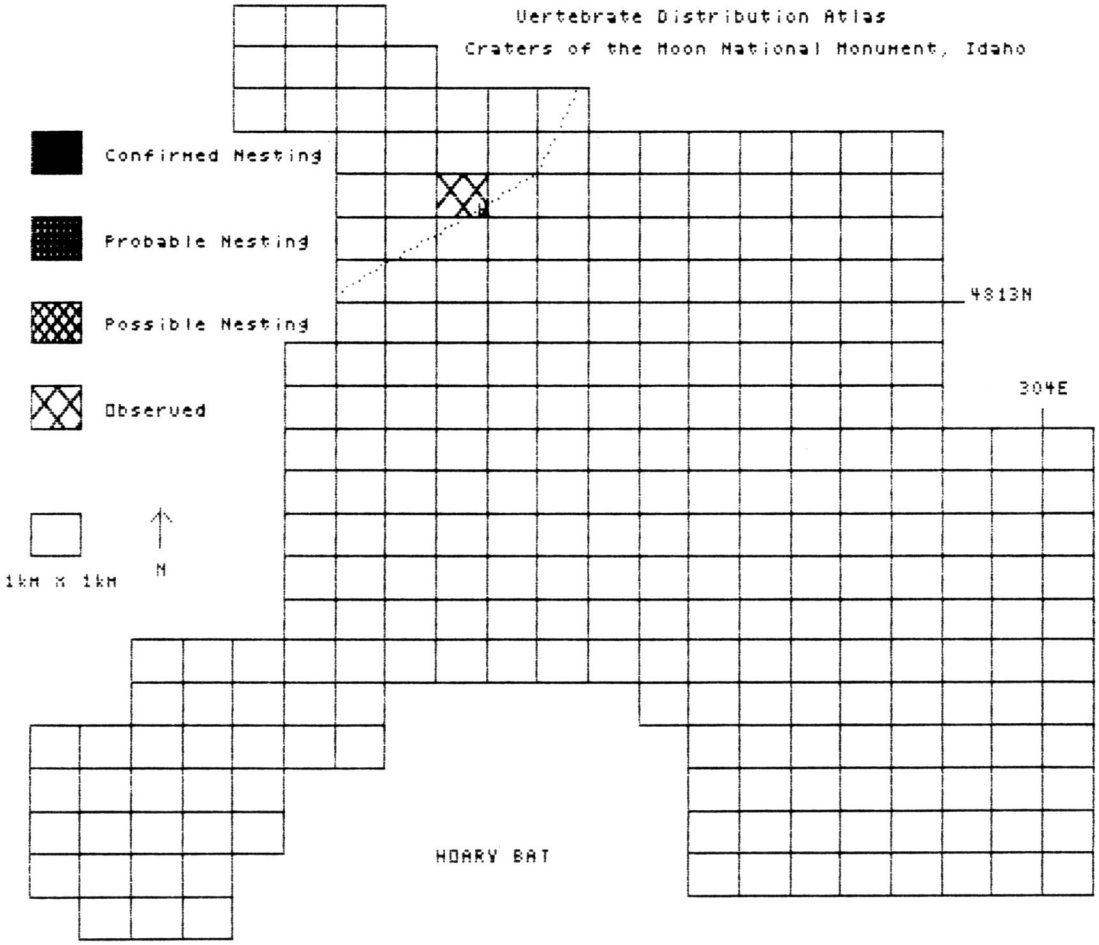

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
MERRIAM'S SHREW

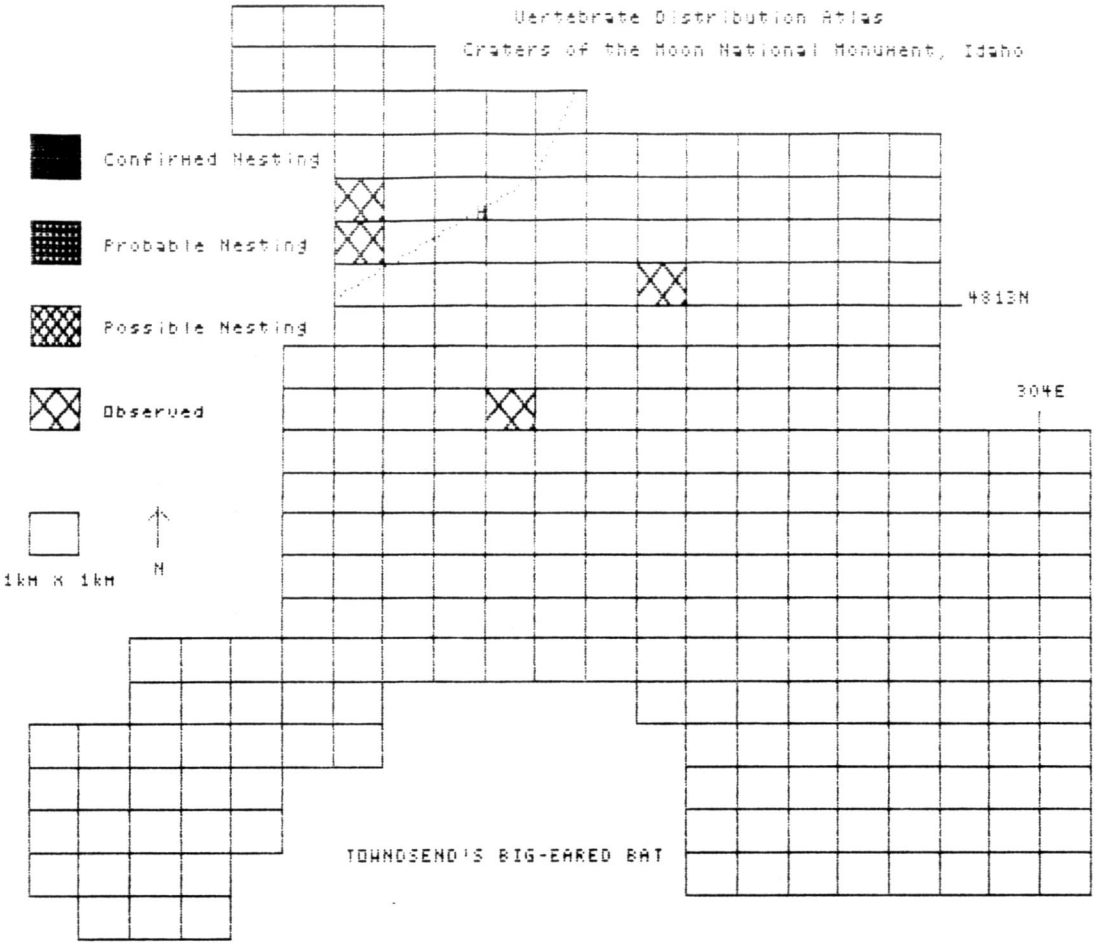

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
LITTLE BROWN BAT

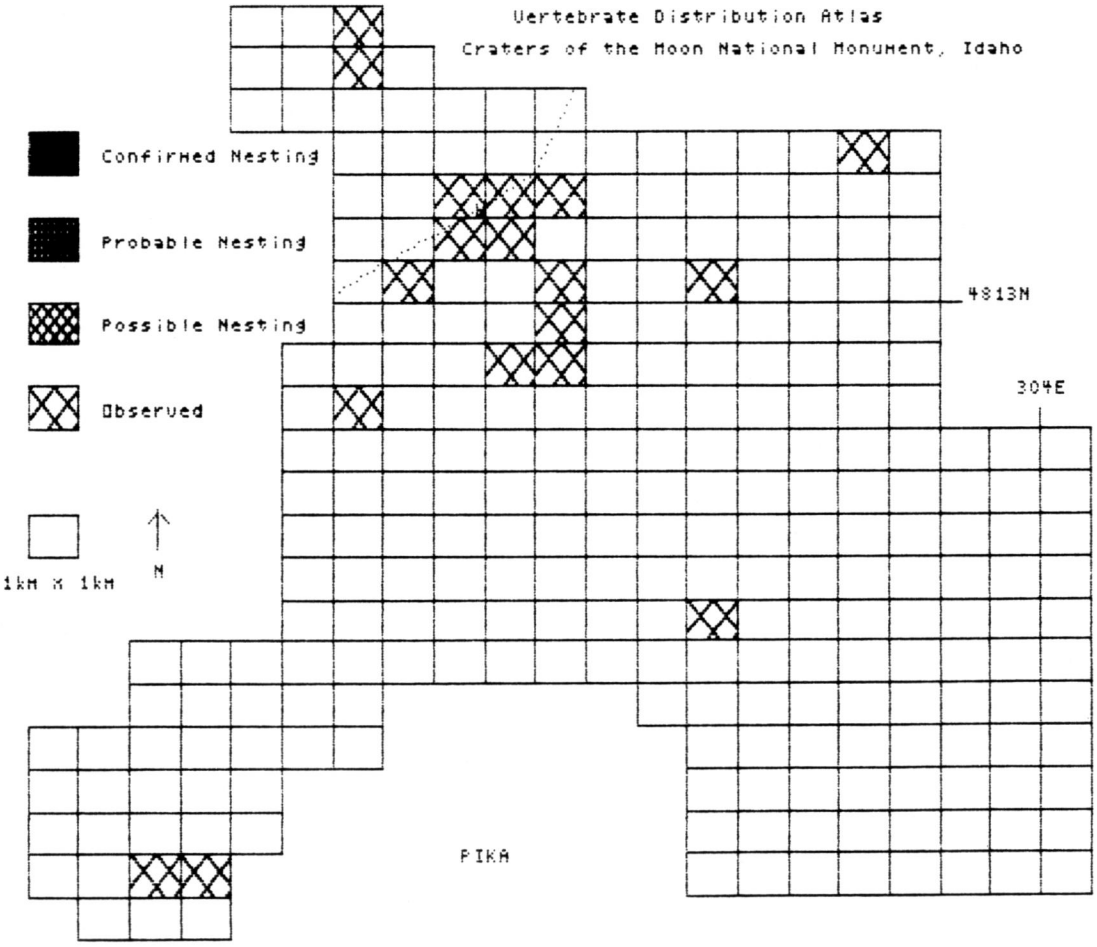

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
LONG-EARED BAT

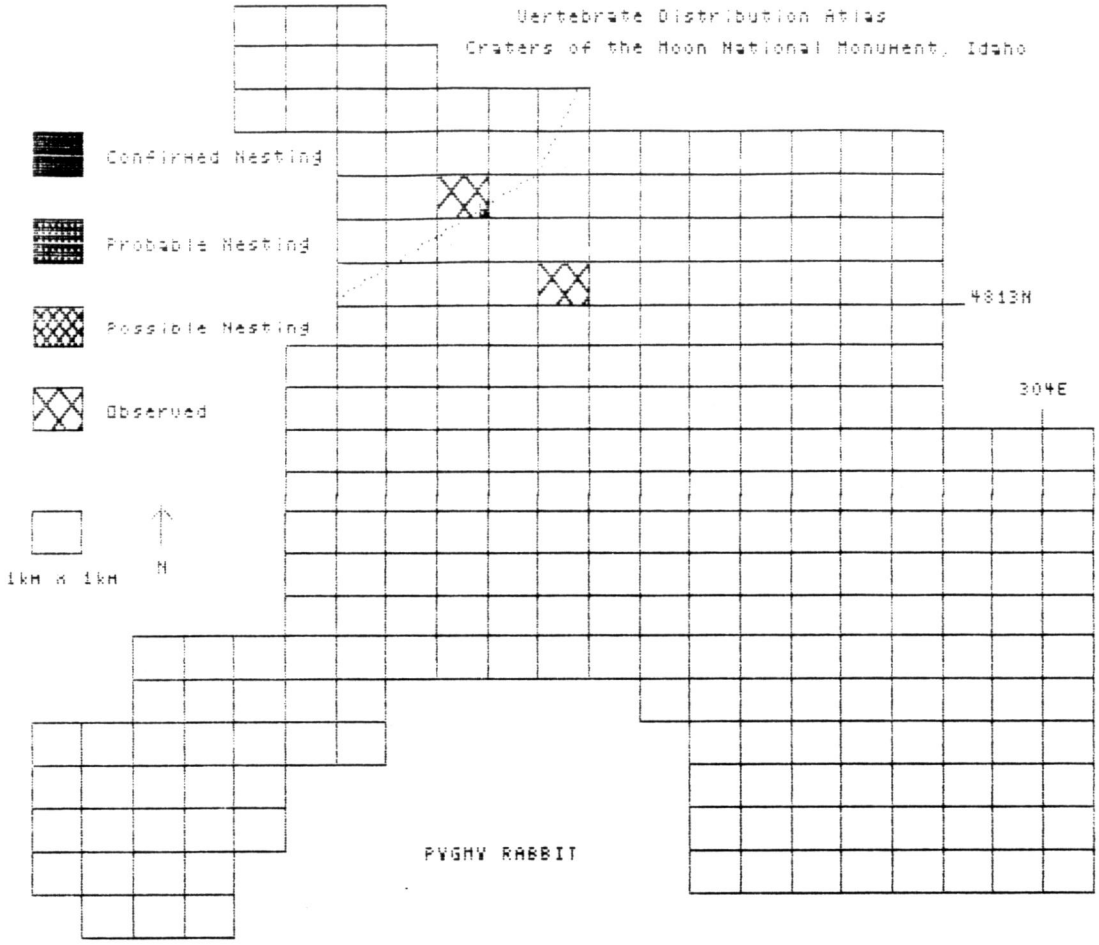

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
CALIFORNIA MYOTIS

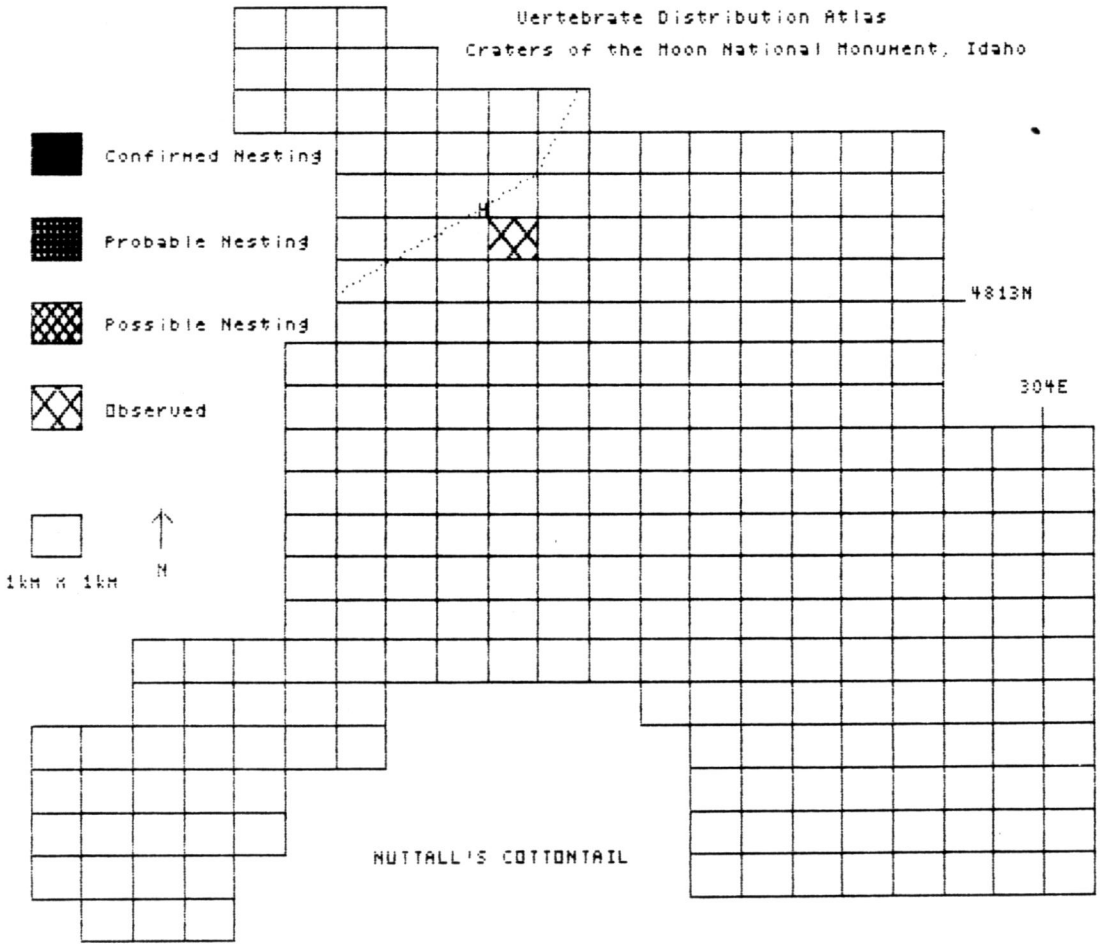

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
SMALL-FOOTED MYOTIS

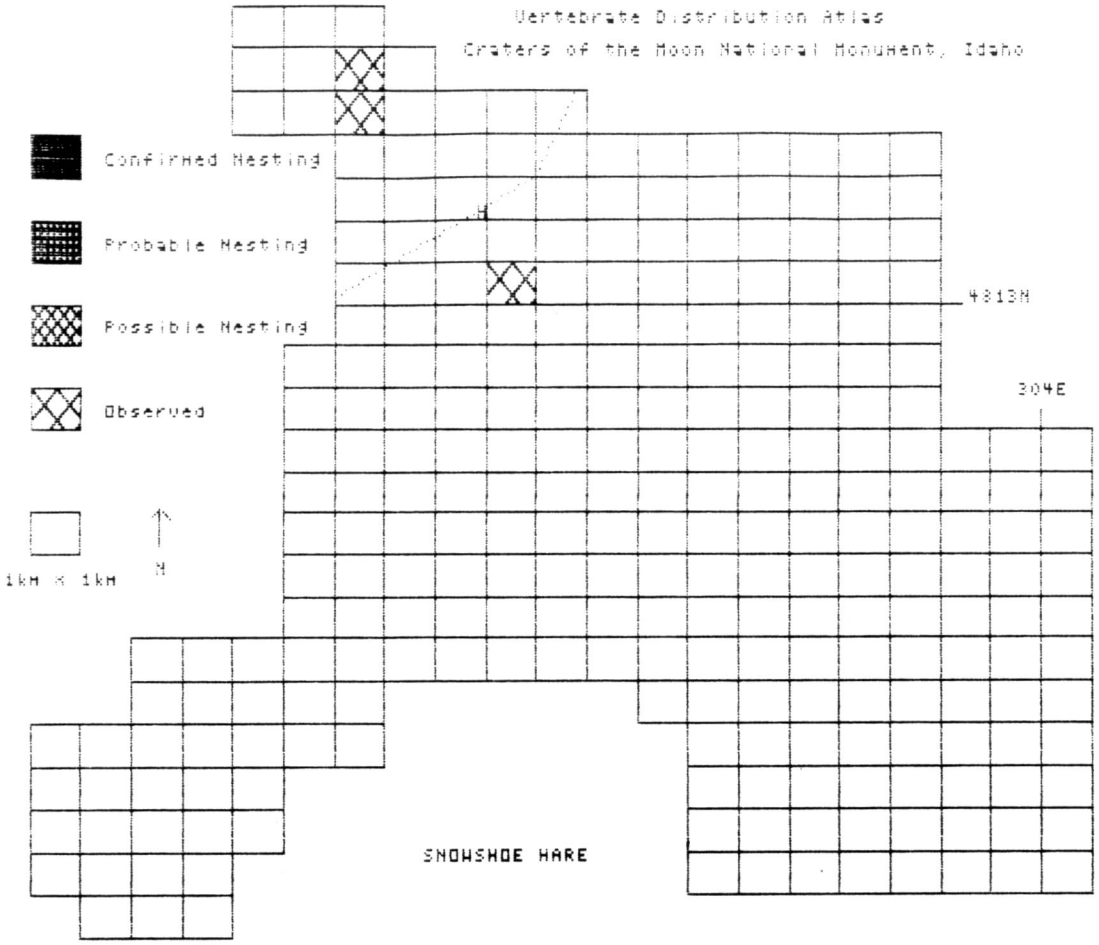

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
HOARY BAT

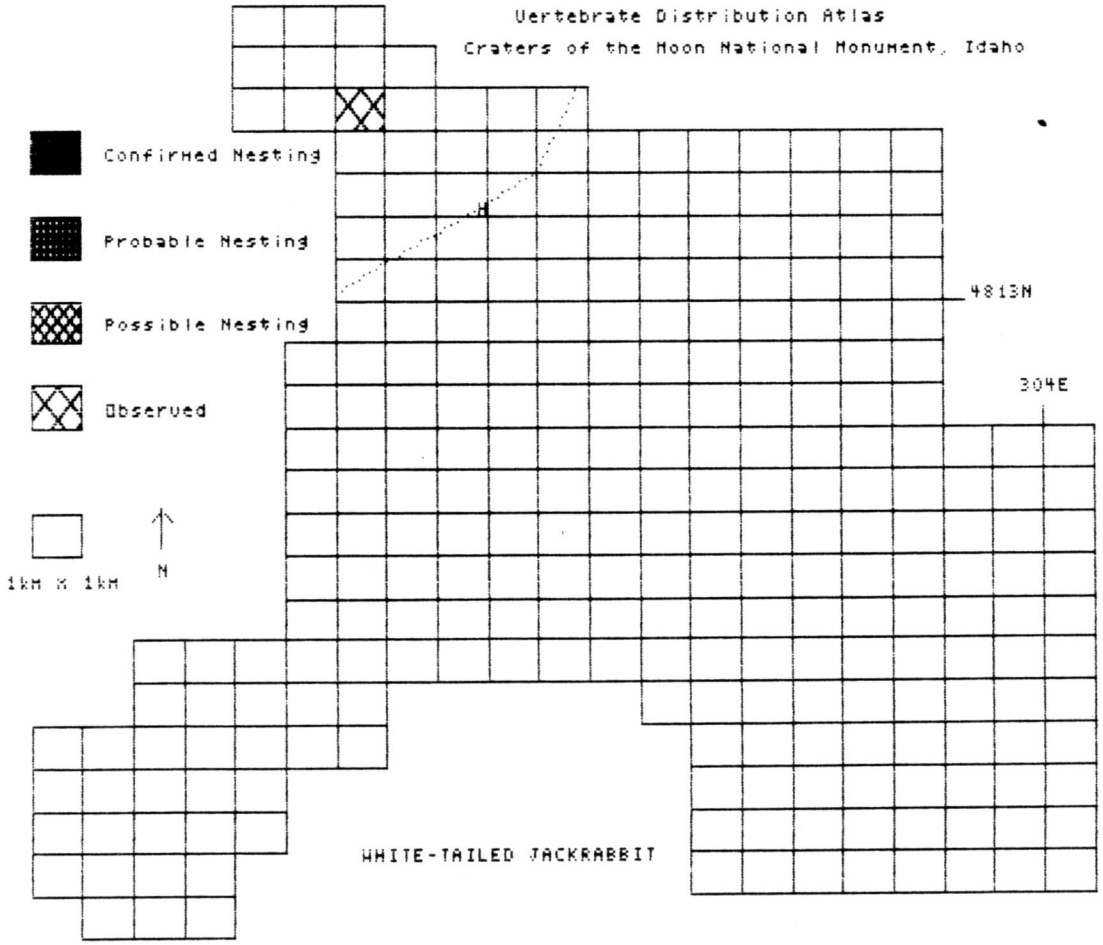

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
TOWNSEND'S BIG-EARED BAT

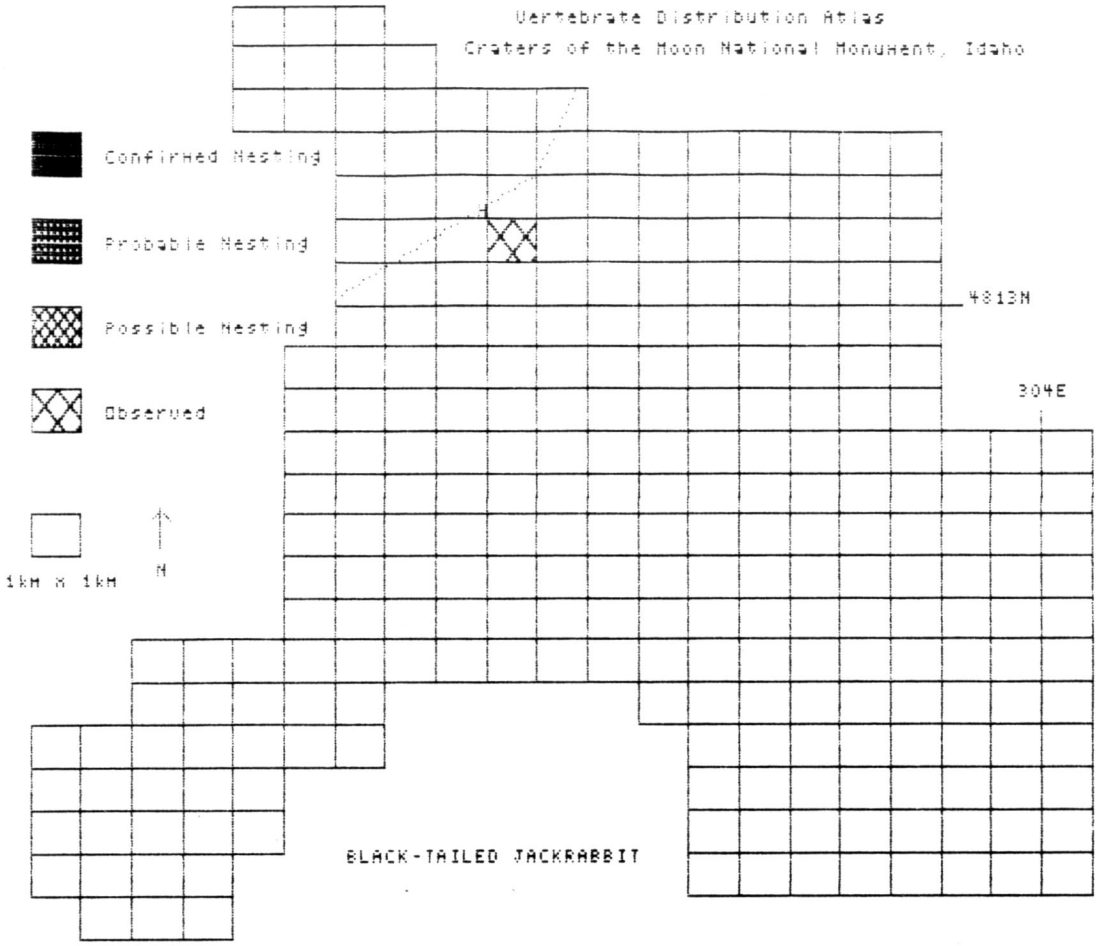

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
PIKA

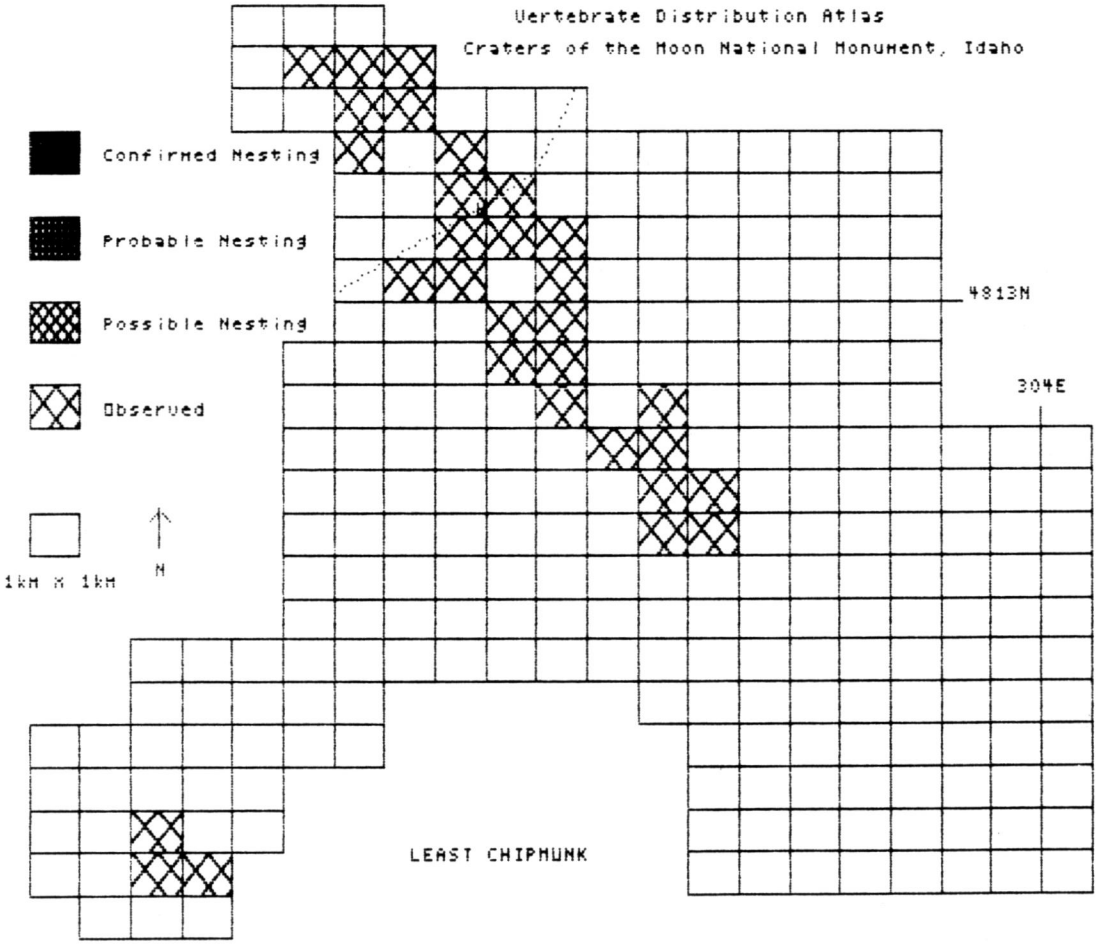

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
PYGMY RABBIT

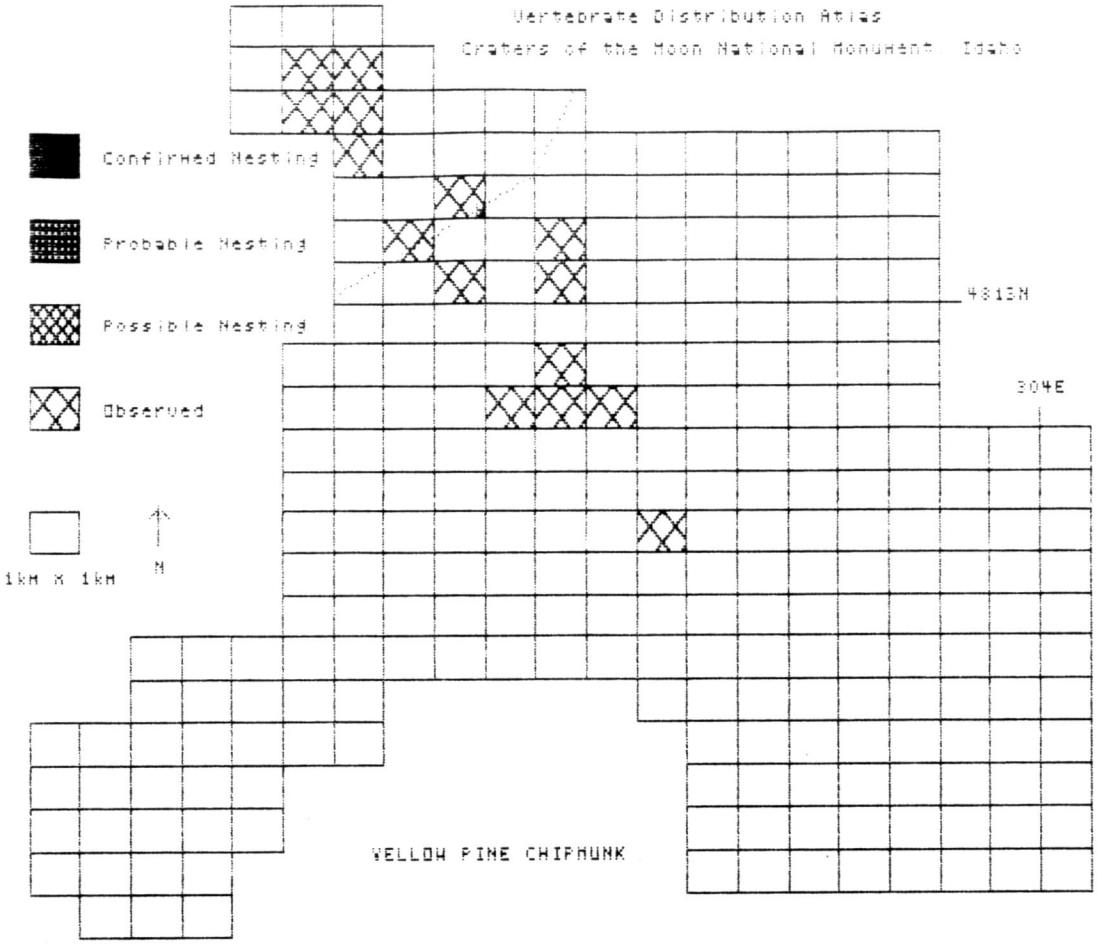

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
NUTTALL'S COTTONTAIL

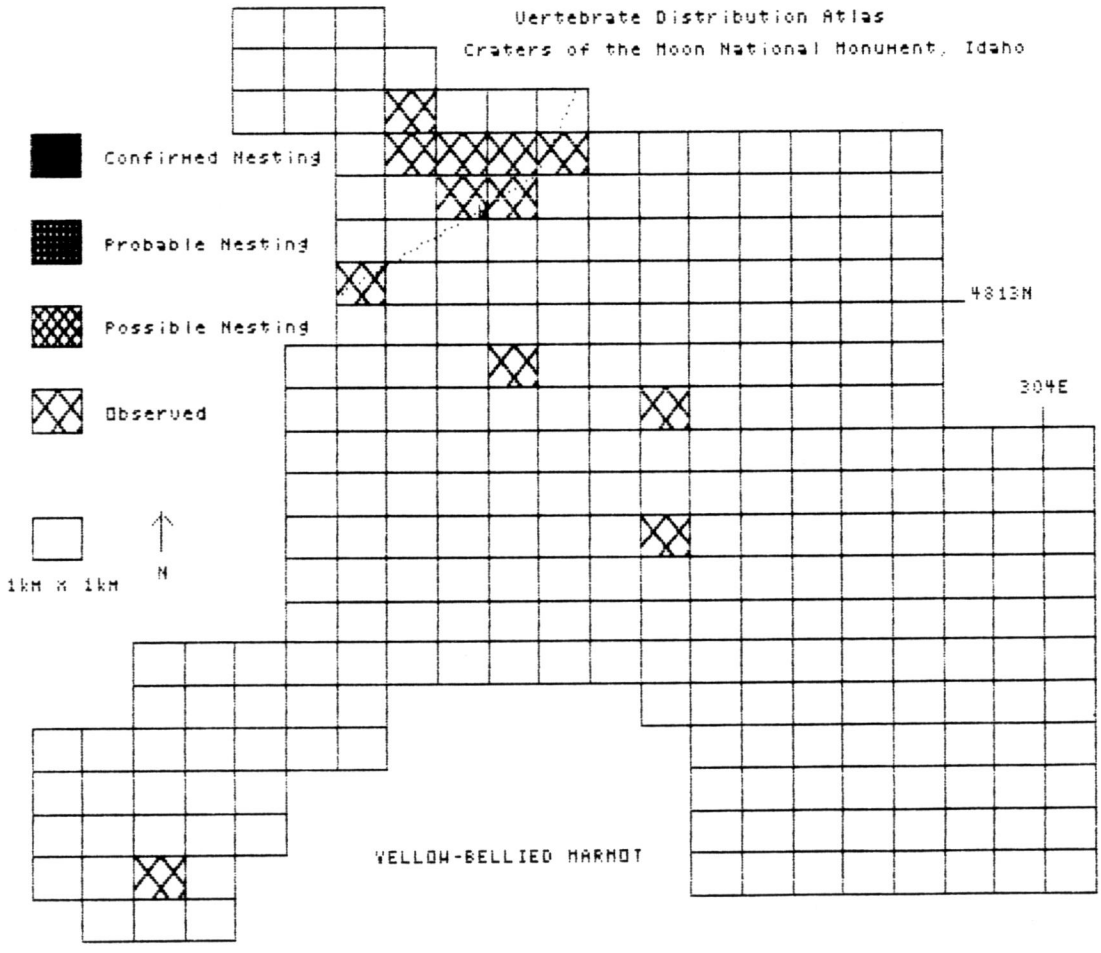

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1km x 1km
N
SNOWSHOE HARE

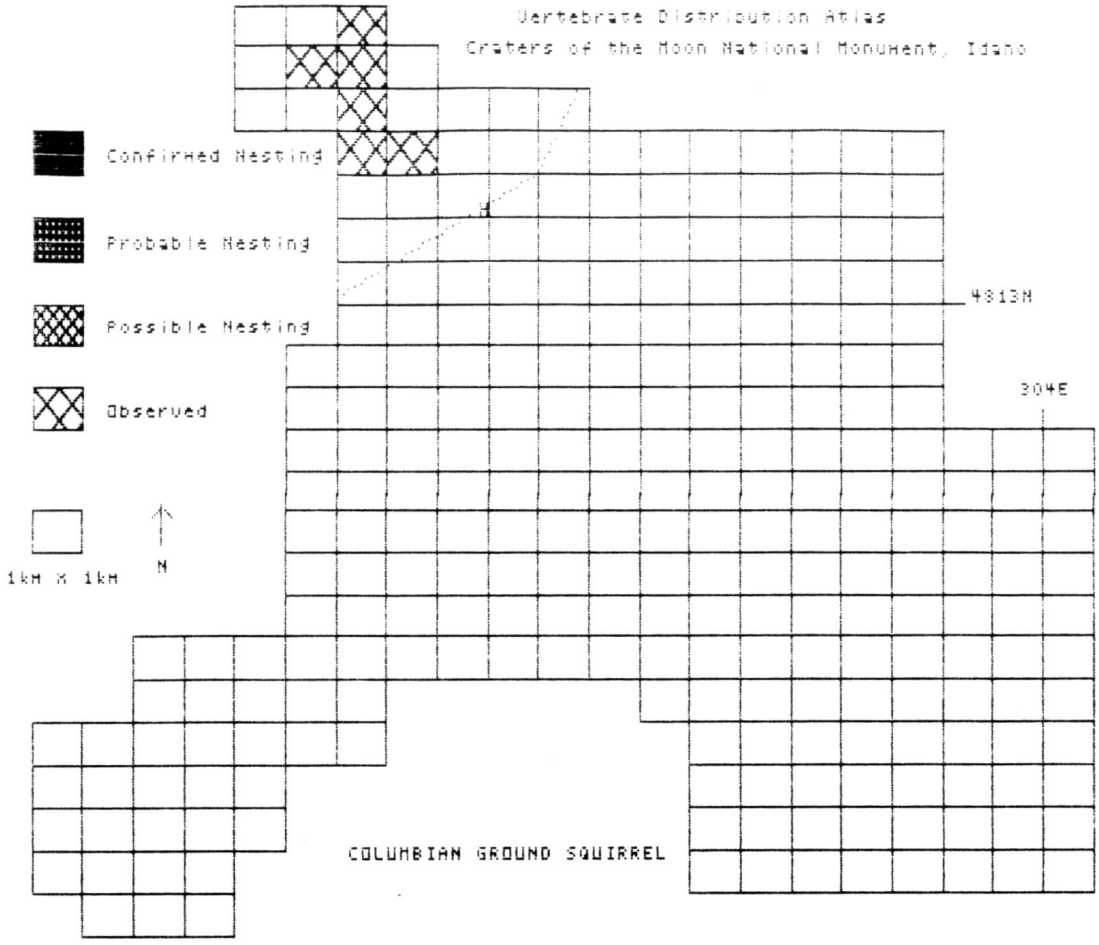

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
4813N
304E
1km x 1km
N
WHITE-TAILED JACKRABBIT

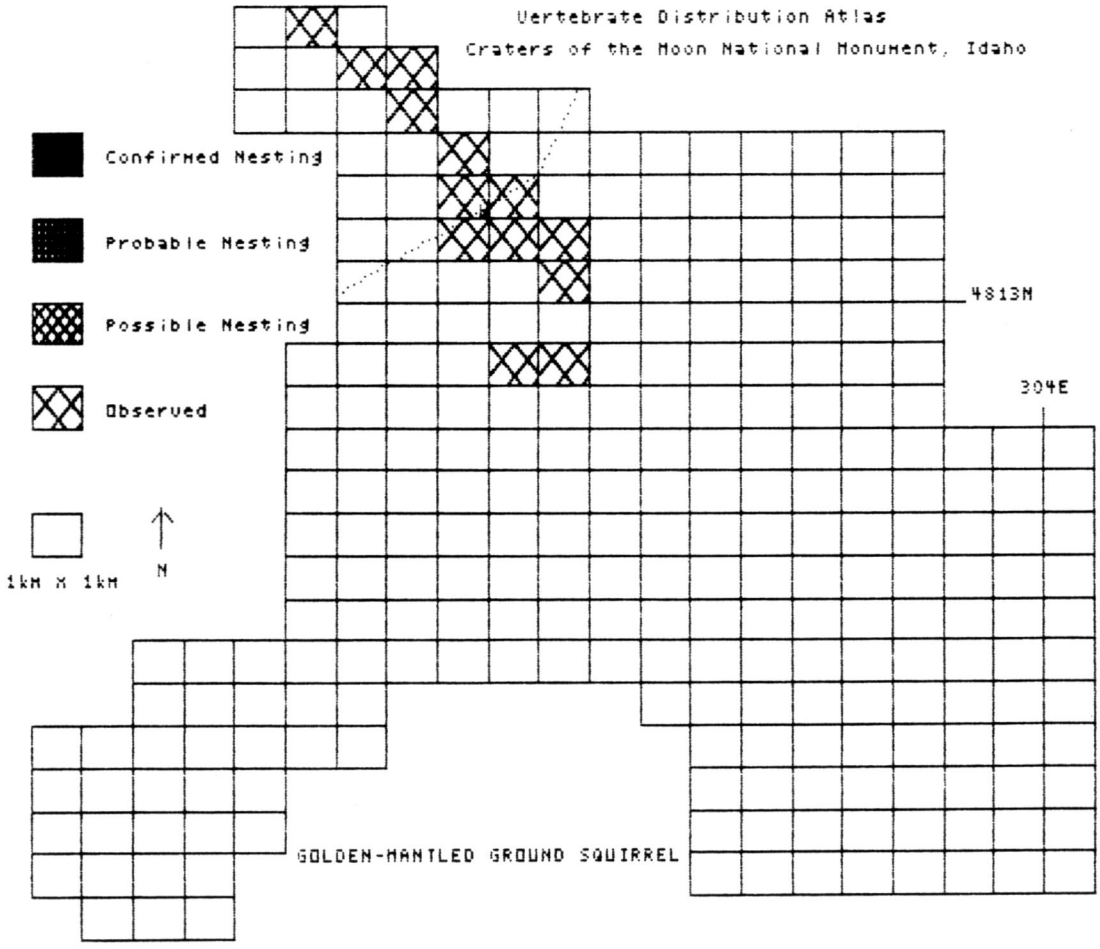

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
BLACK-TAILED JACKRABBIT

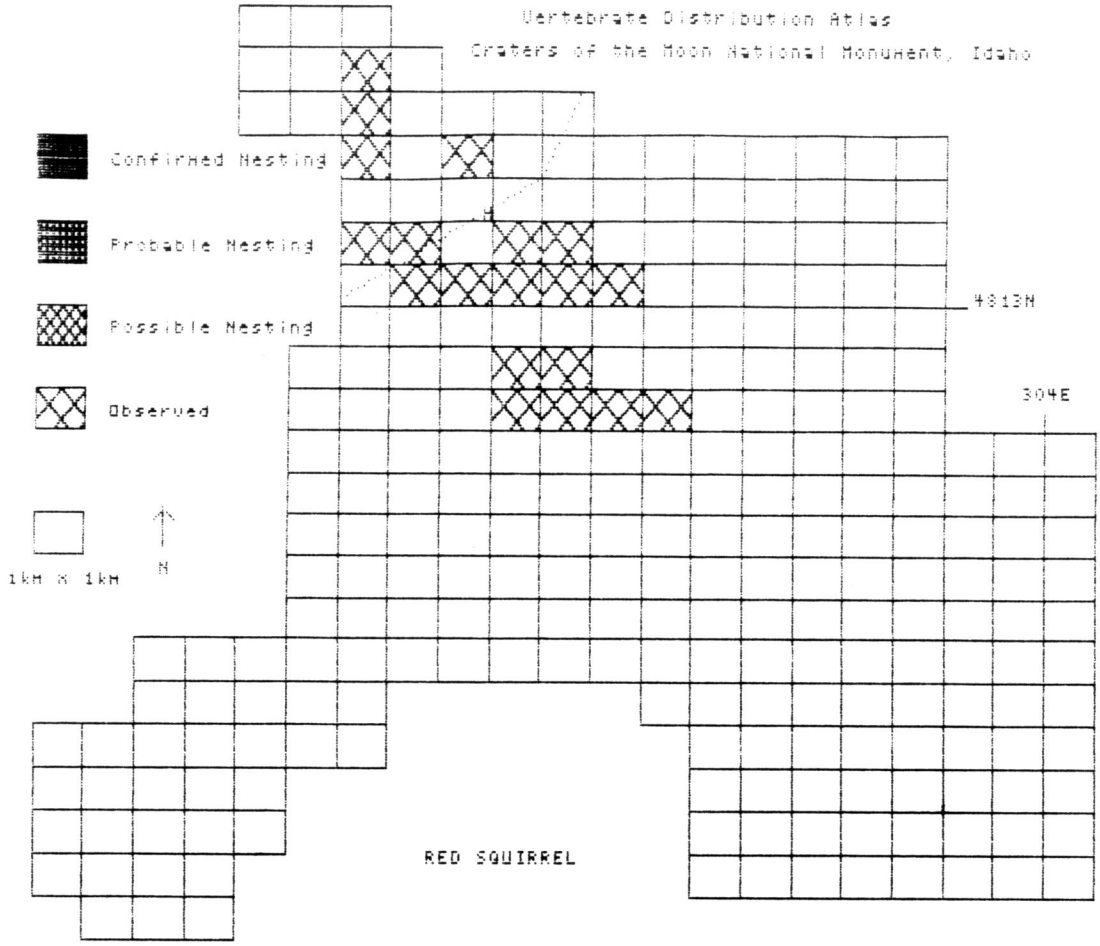

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
LEAST CHIPMUNK

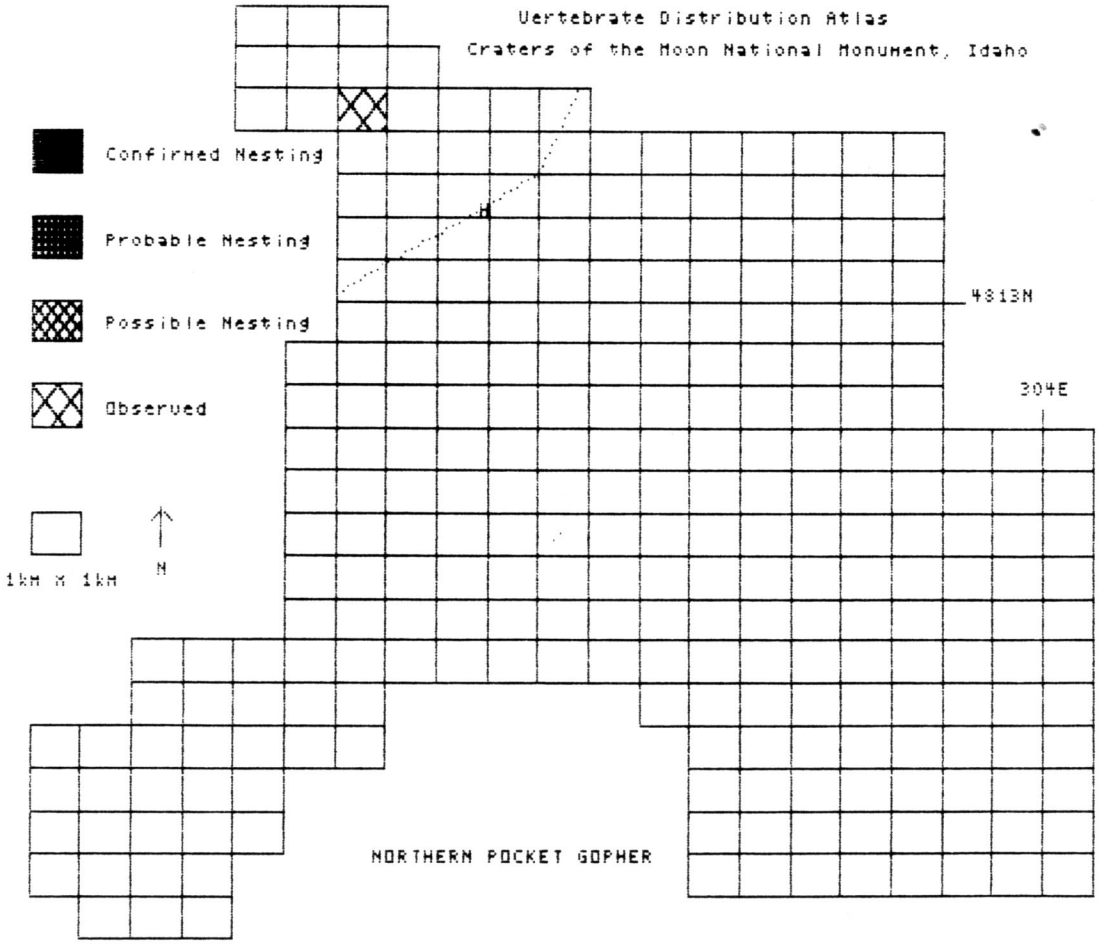

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
YELLOW PINE CHIPMUNK

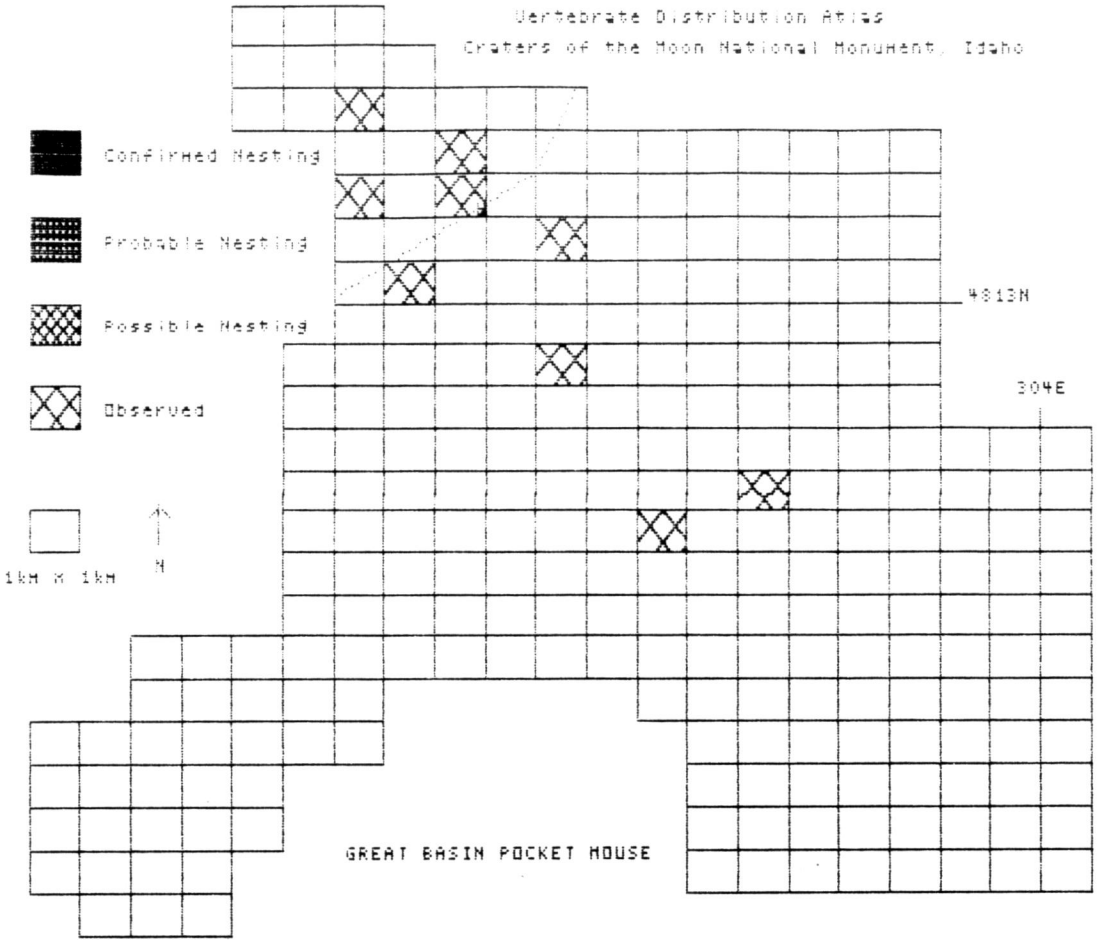

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
YELLOW-BELLIED MARMOT

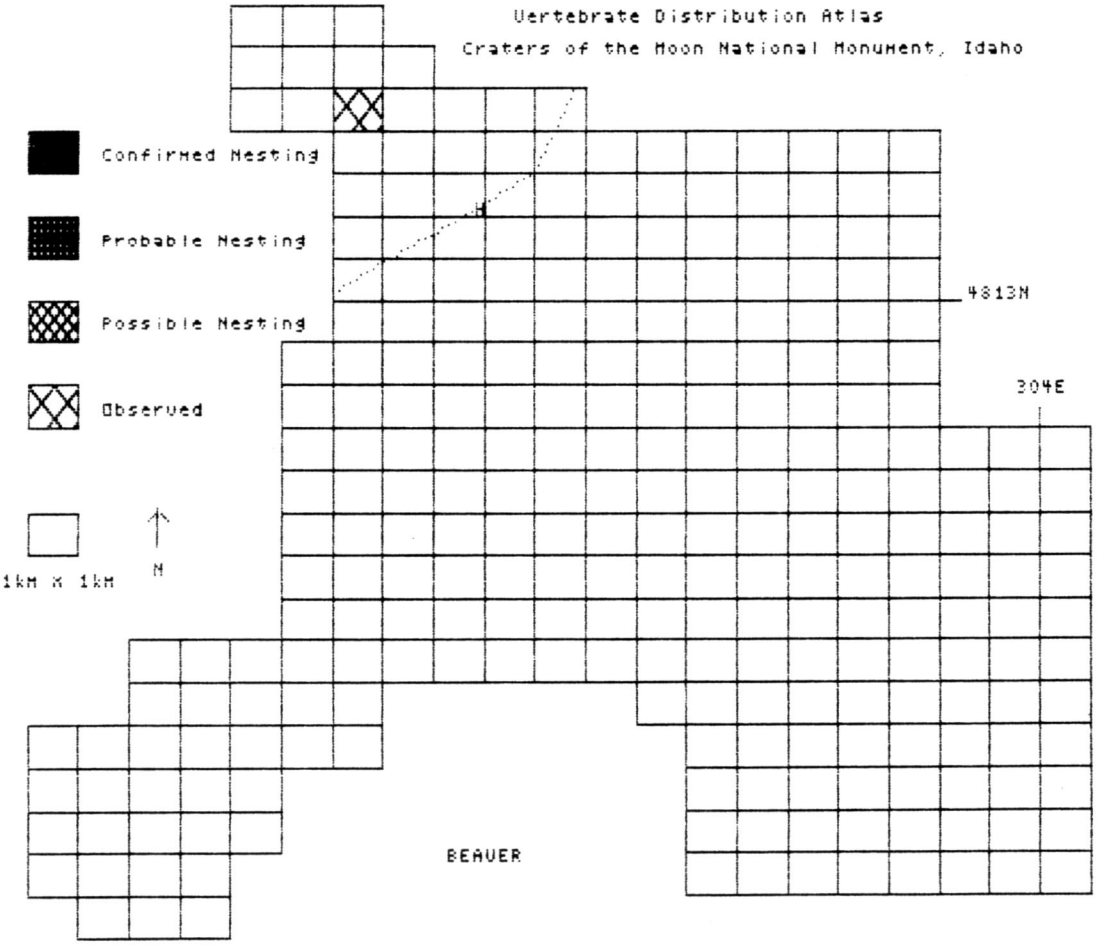

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
COLUMBIAN GROUND SQUIRREL

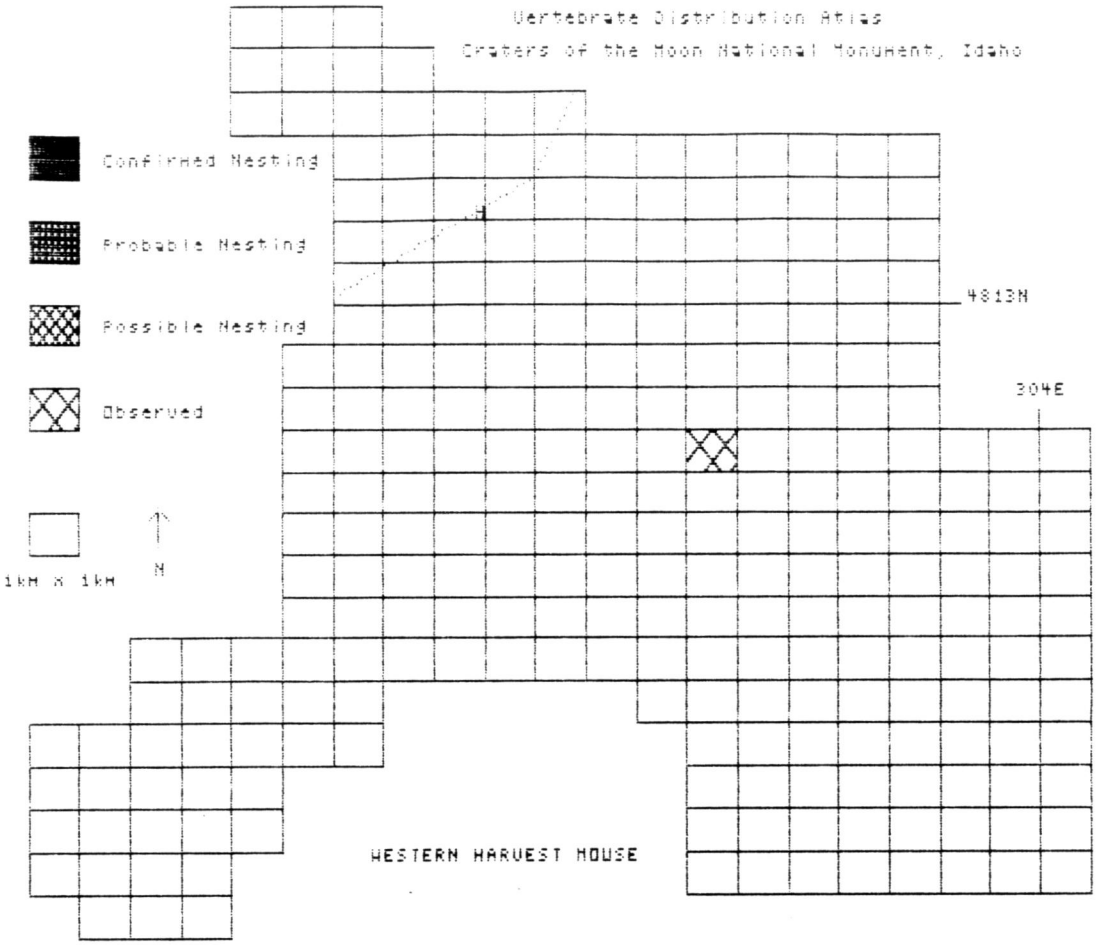

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
GOLDEN-MANTLED GROUND SQUIRREL

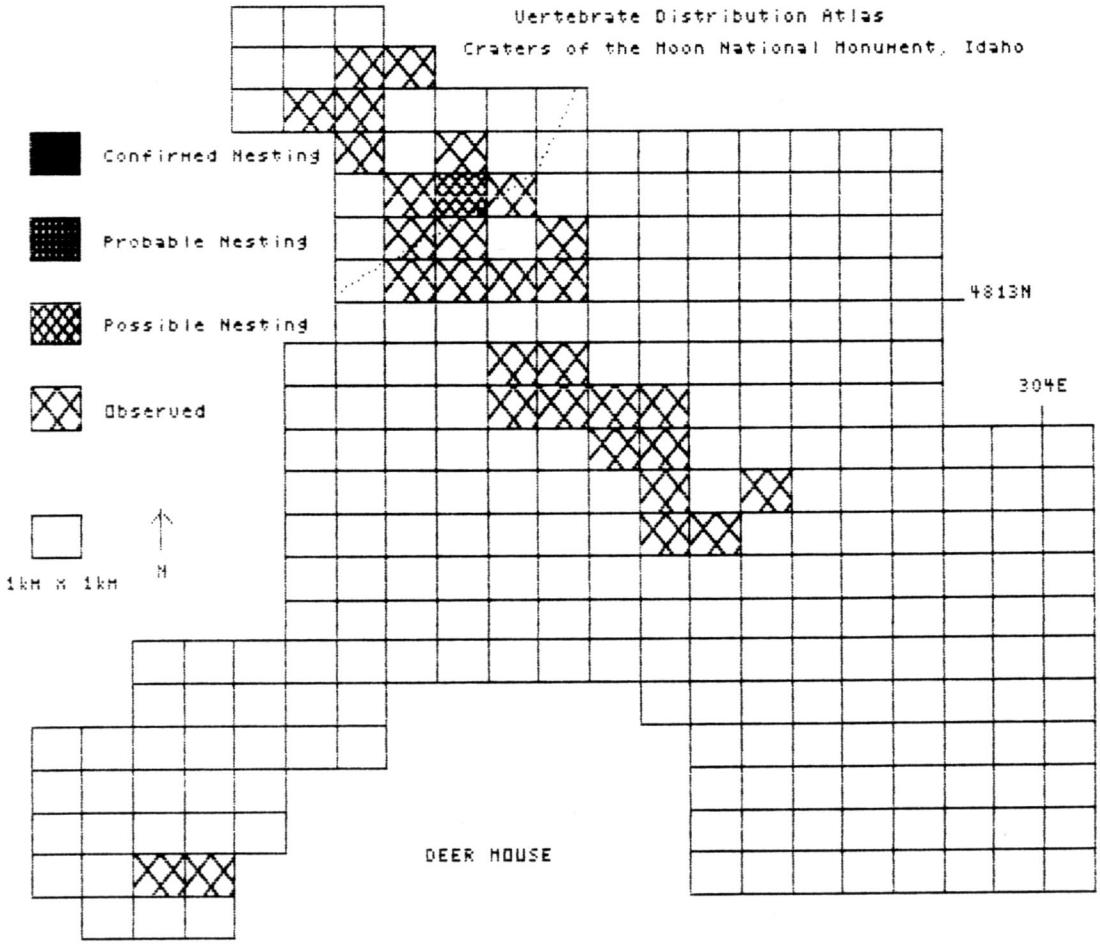

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
RED SQUIRREL

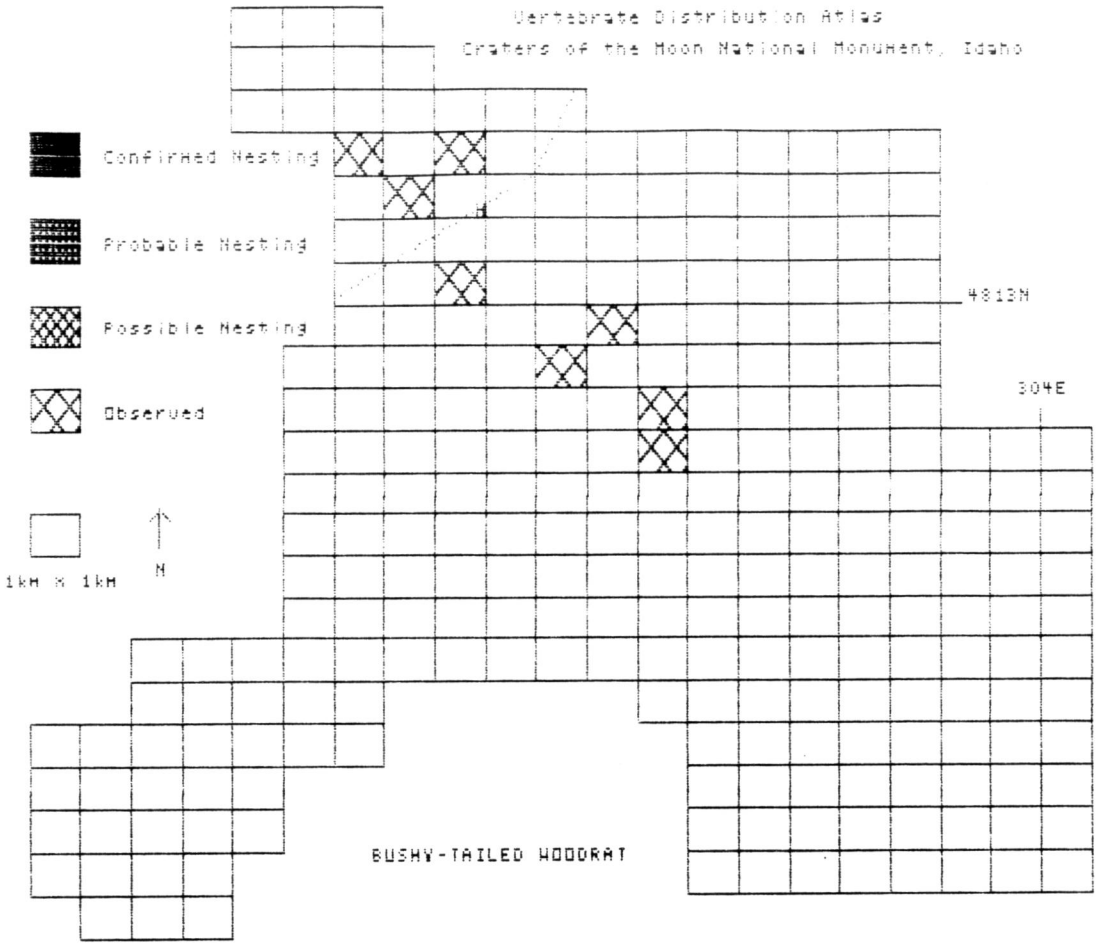

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
NORTHERN POCKET GOPHER

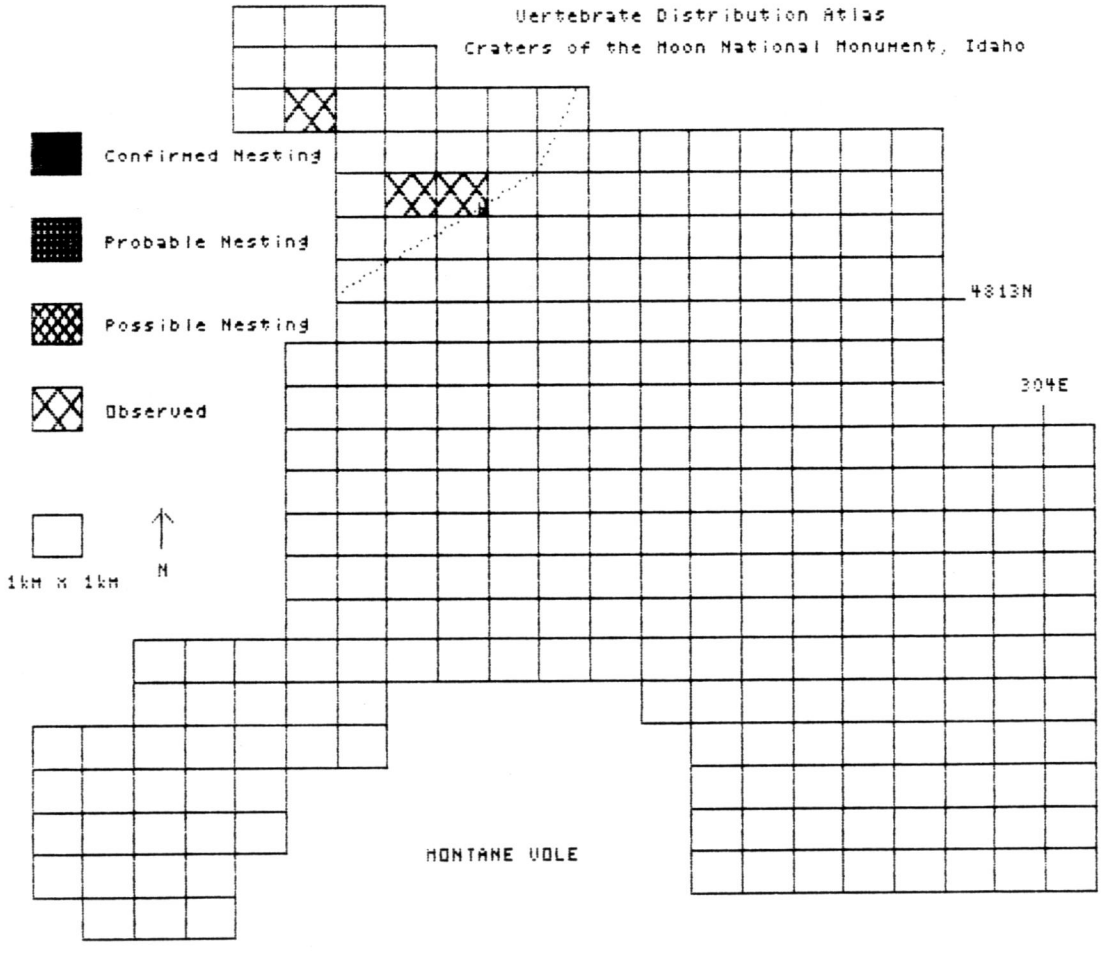

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
GREAT BASIN POCKET MOUSE

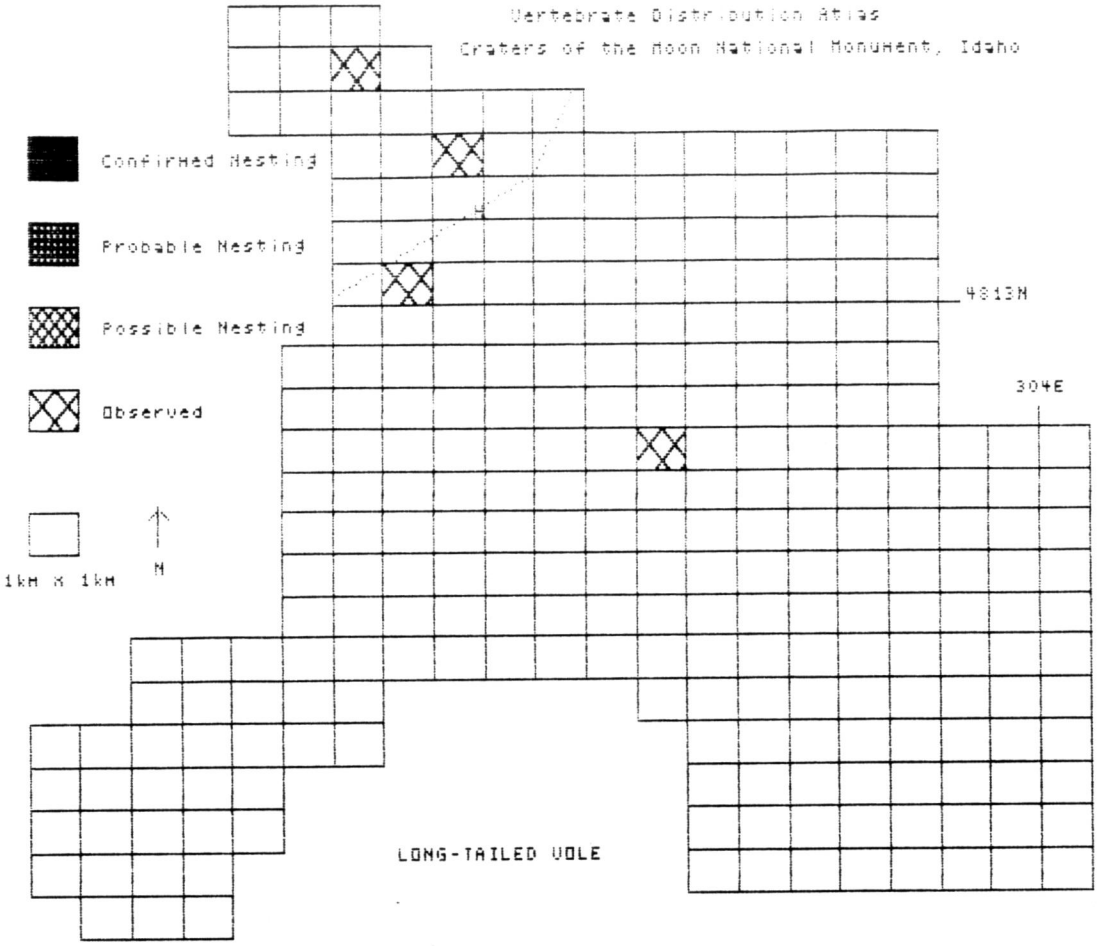

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
BEAVER

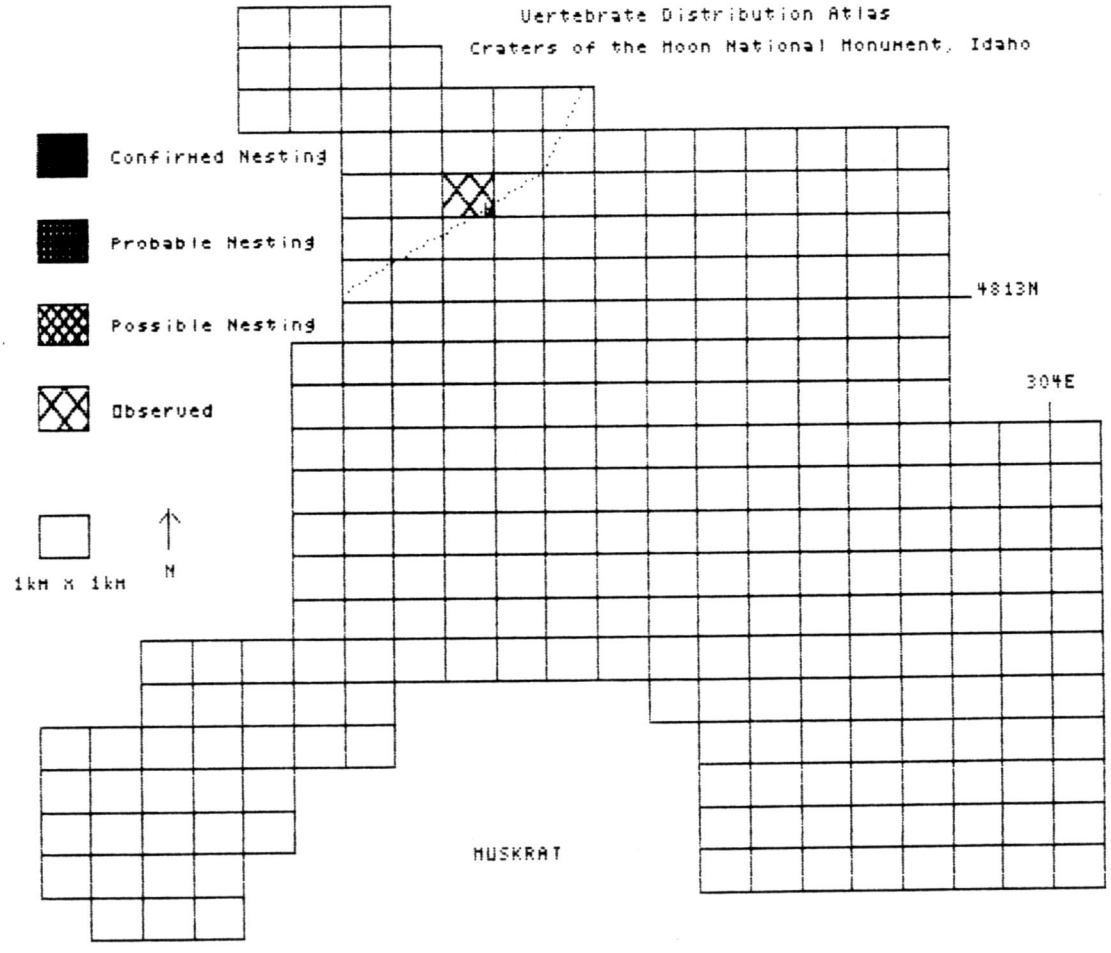

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
WESTERN HARVEST MOUSE

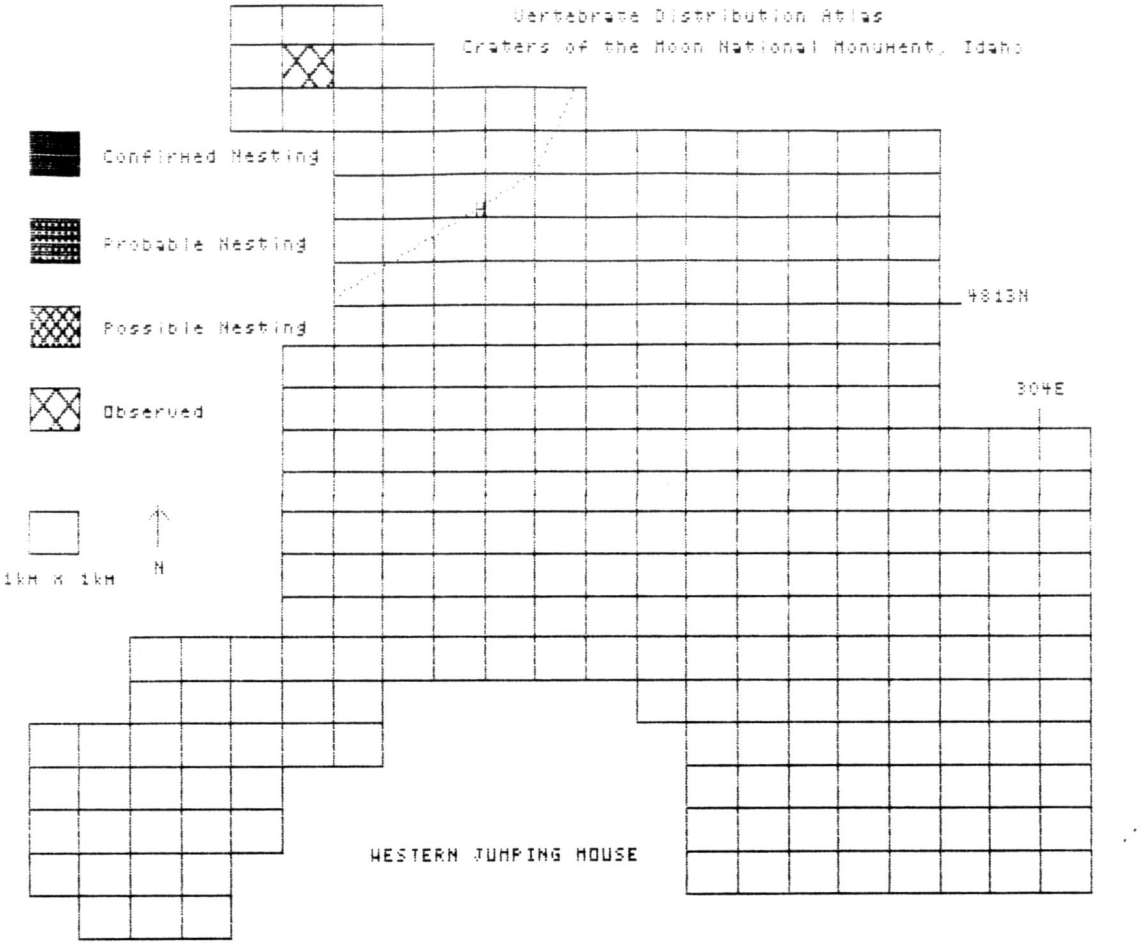

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
DEER MOUSE

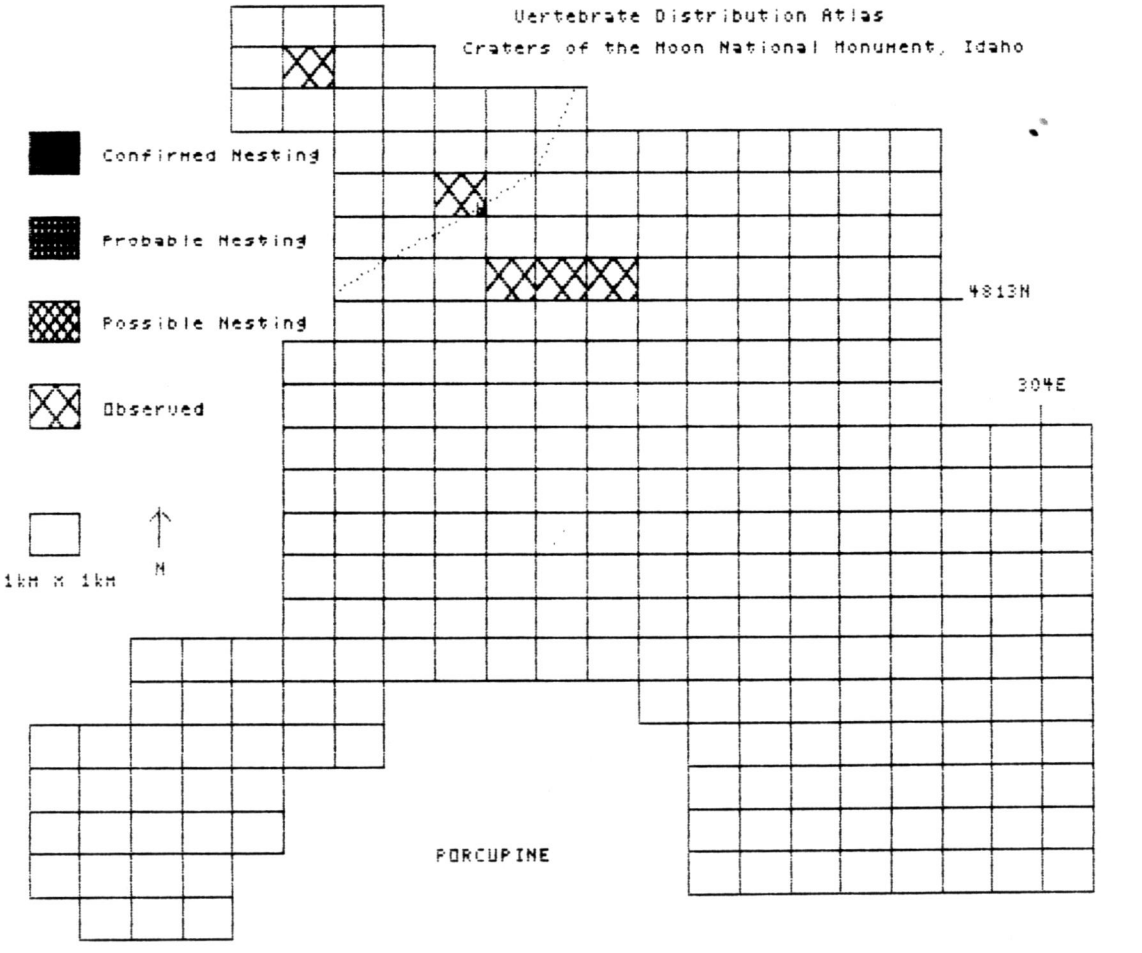

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
BUSHY-TAILED WOODRAT

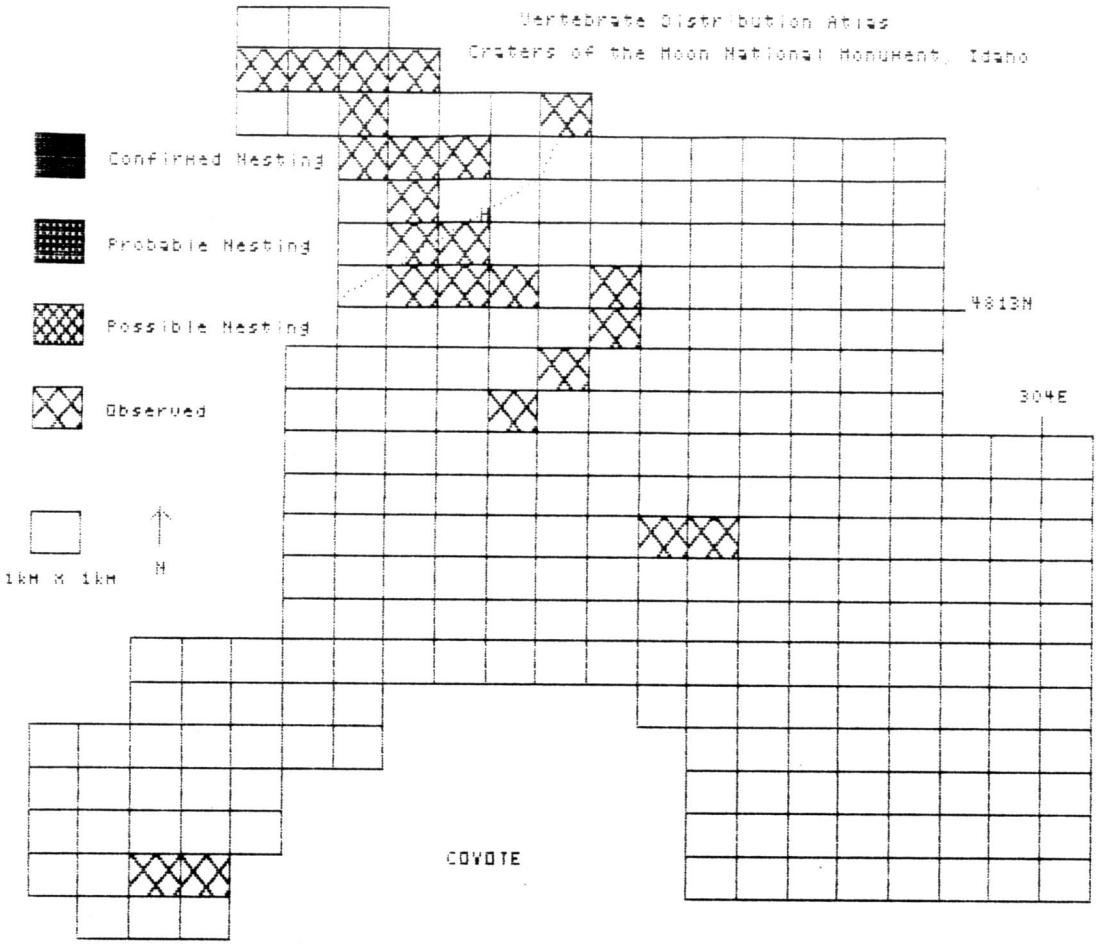

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
MONTANE VOLE

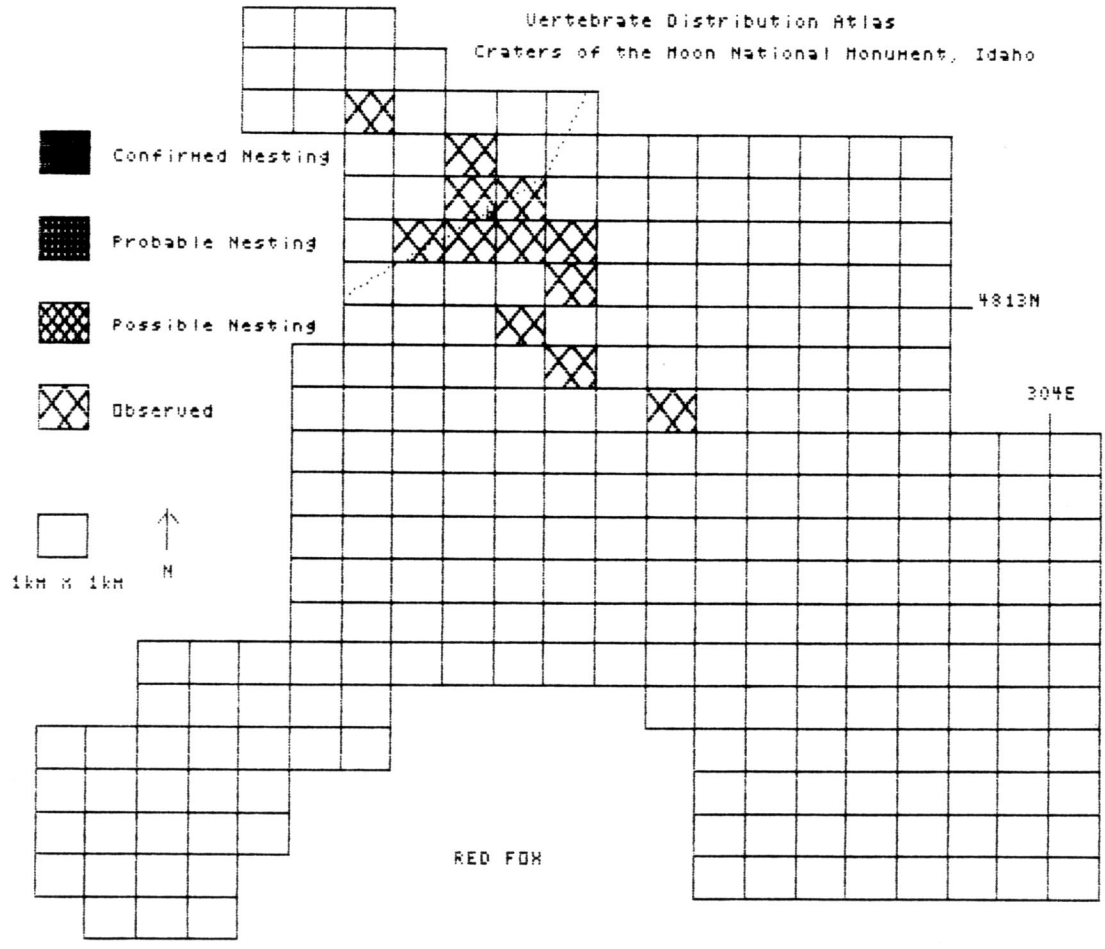

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
LONG-TAILED VOLE

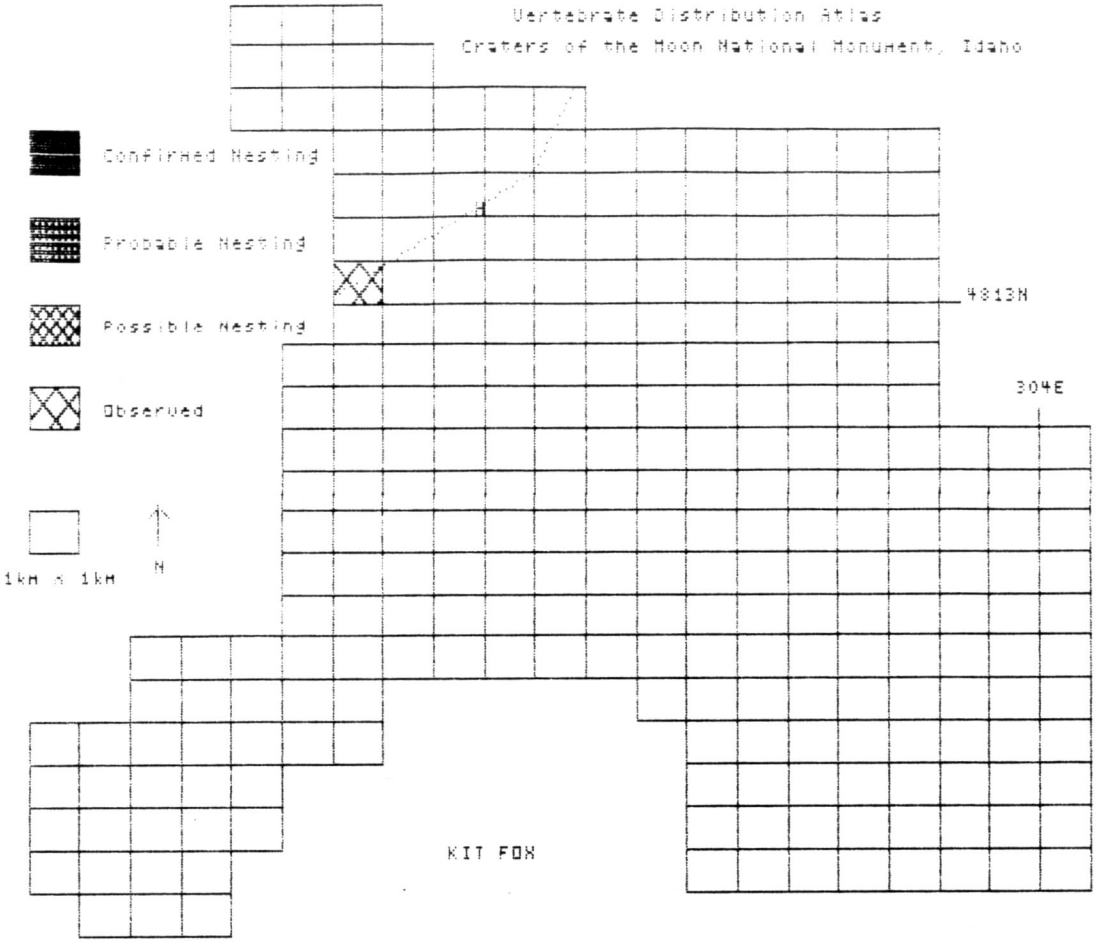

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
MUSKRAT

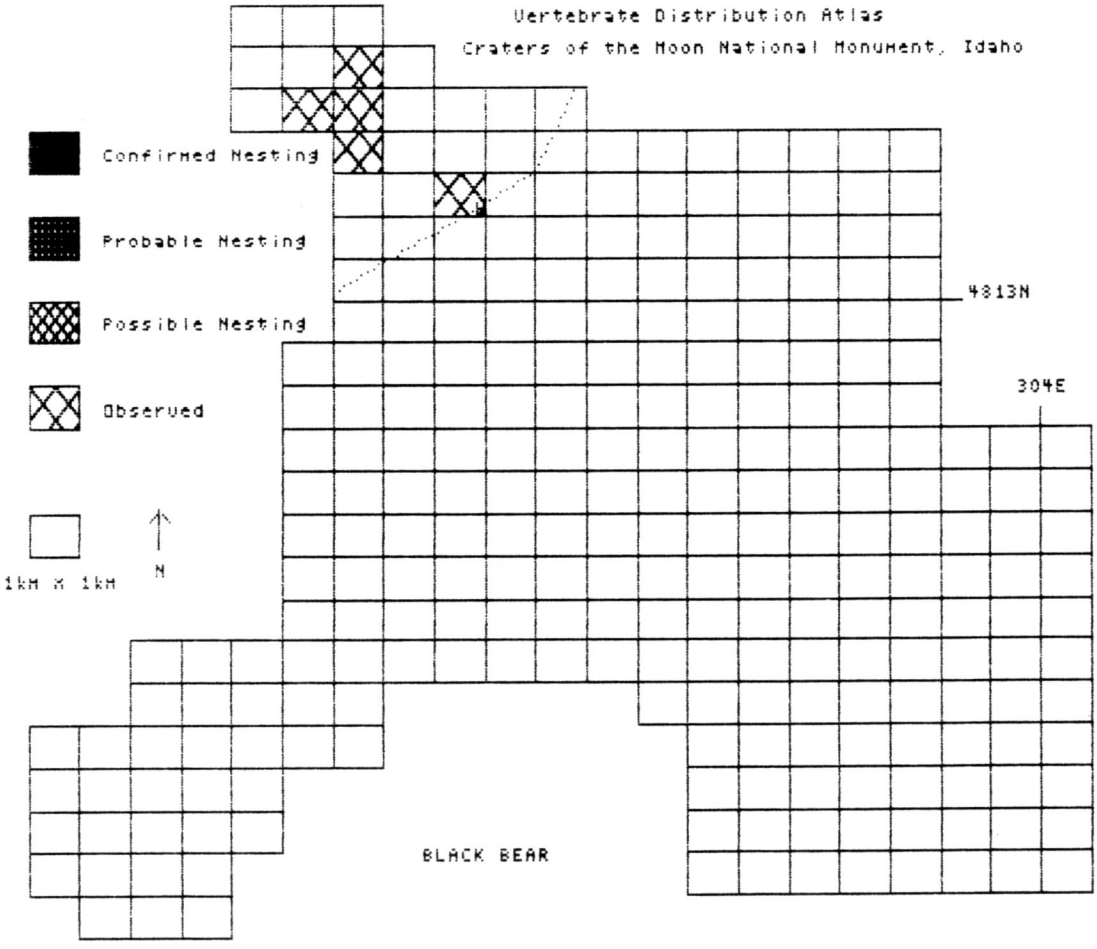

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
WESTERN JUMPING MOUSE

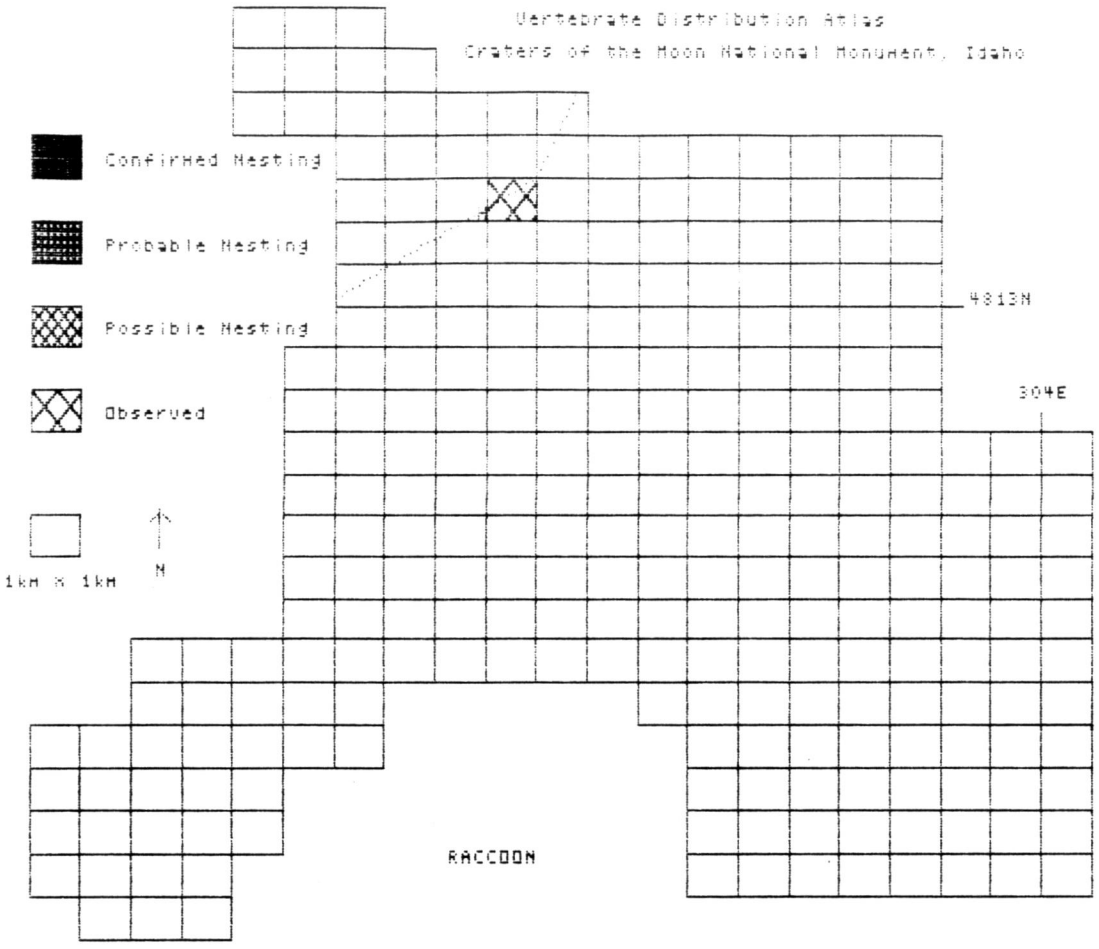

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
PORCUPINE

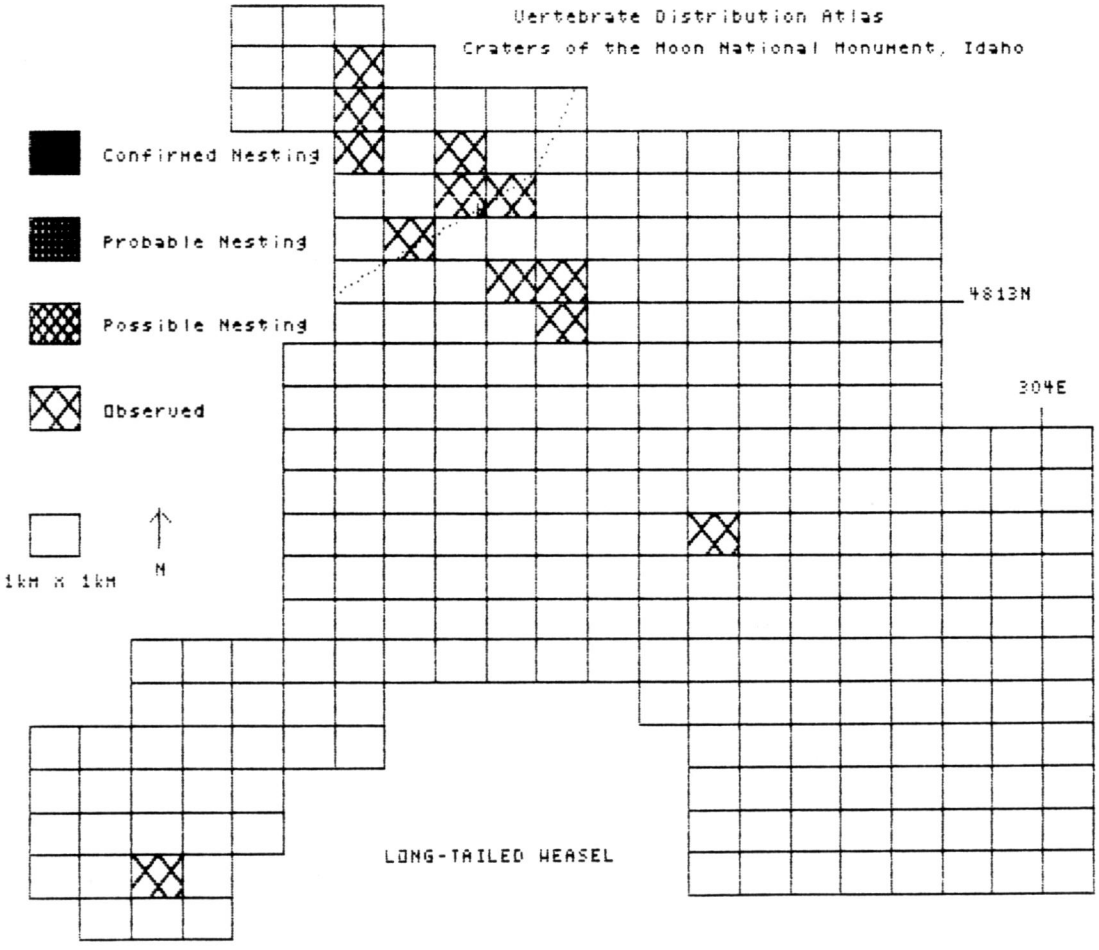

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM X 1kM
N
4813N
304E
COYOTE

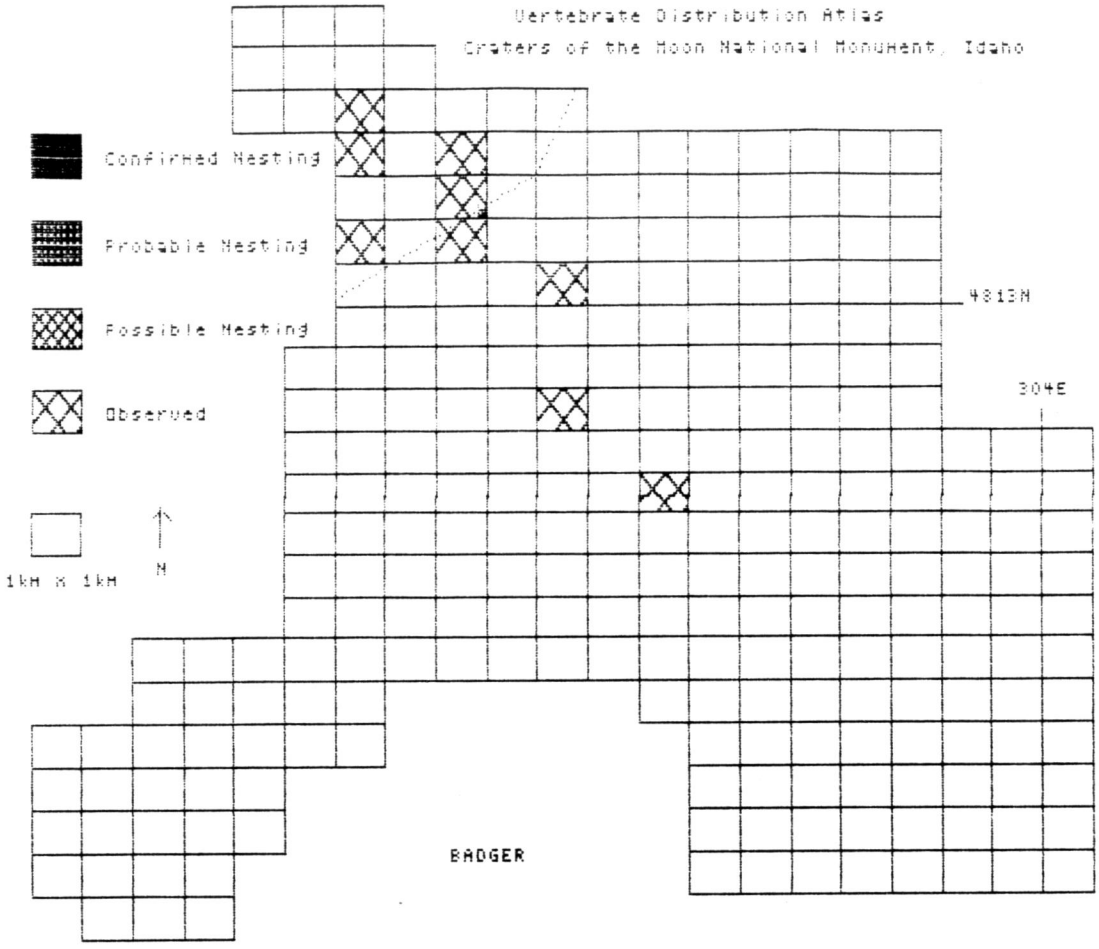

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM X 1kM
N
4813N
304E
RED FOX

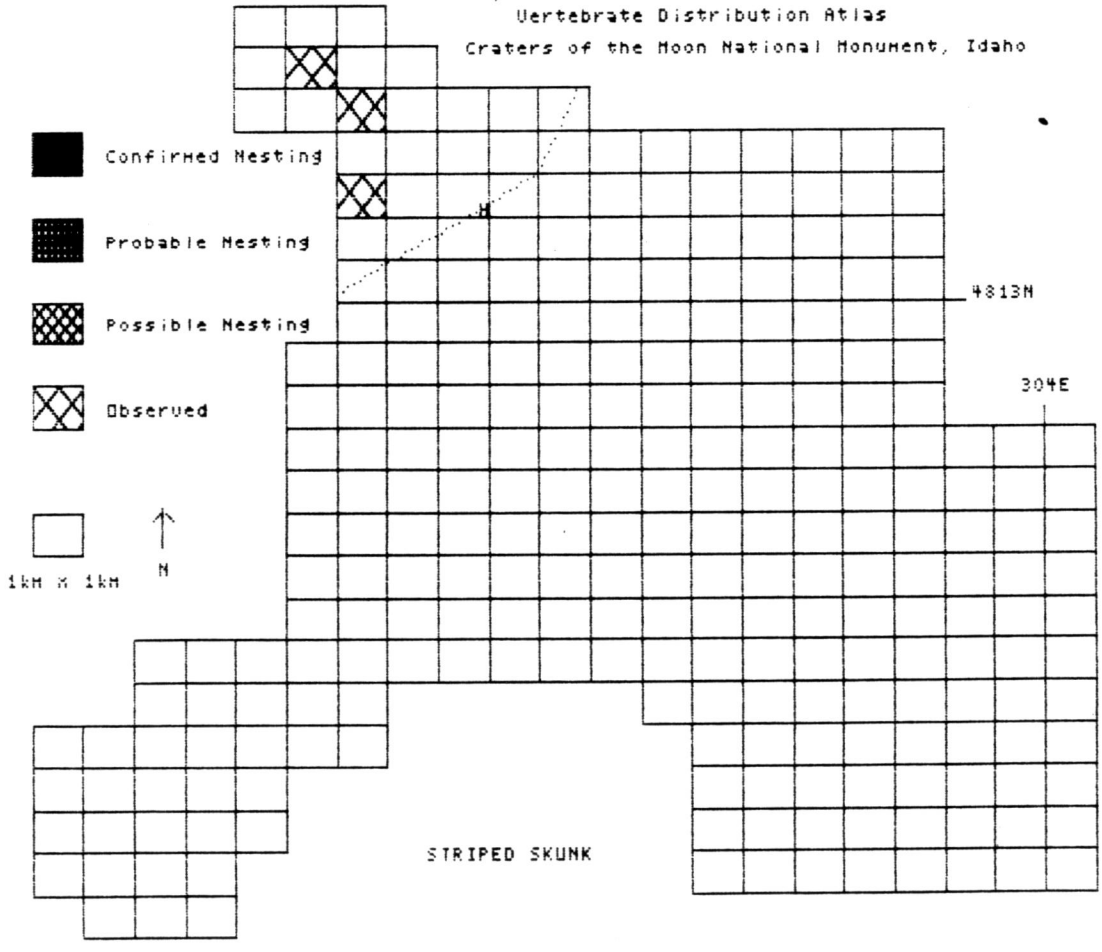

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
KIT FOX

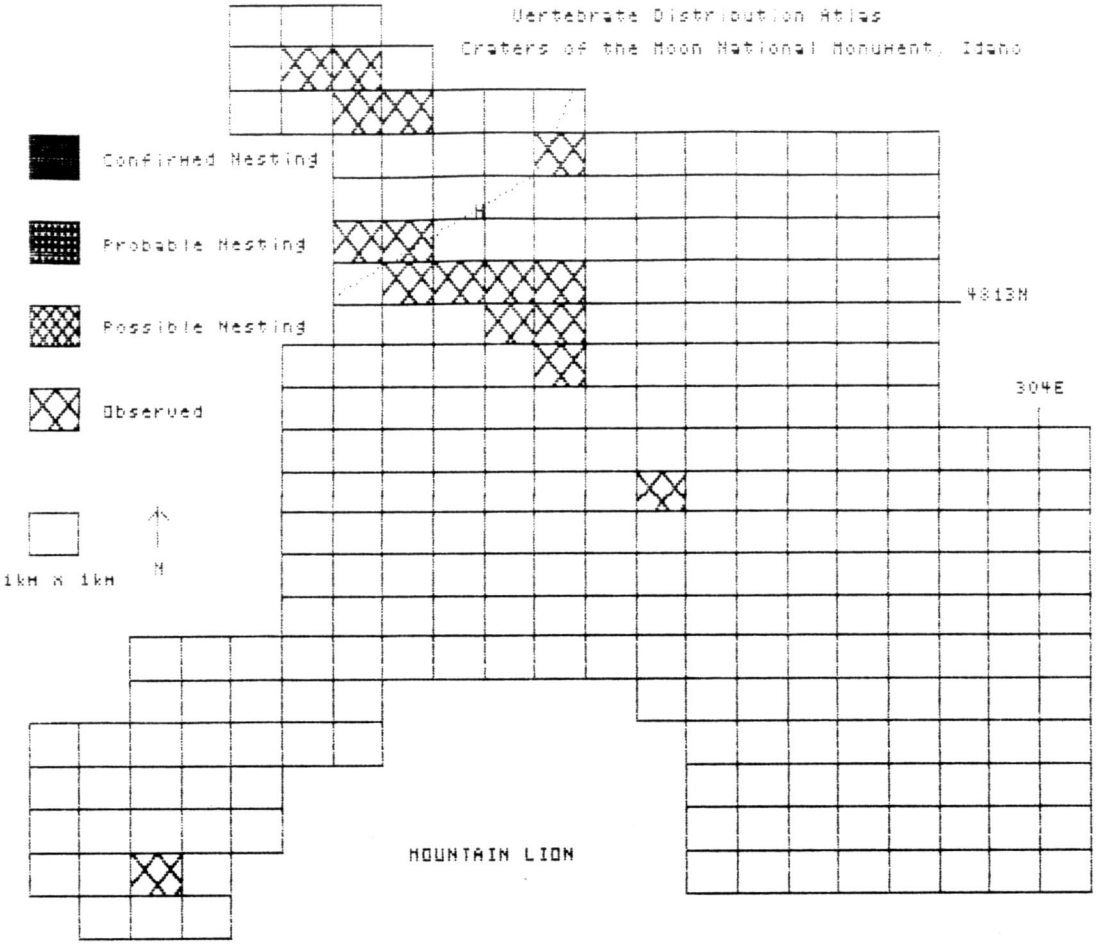

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
BLACK BEAR

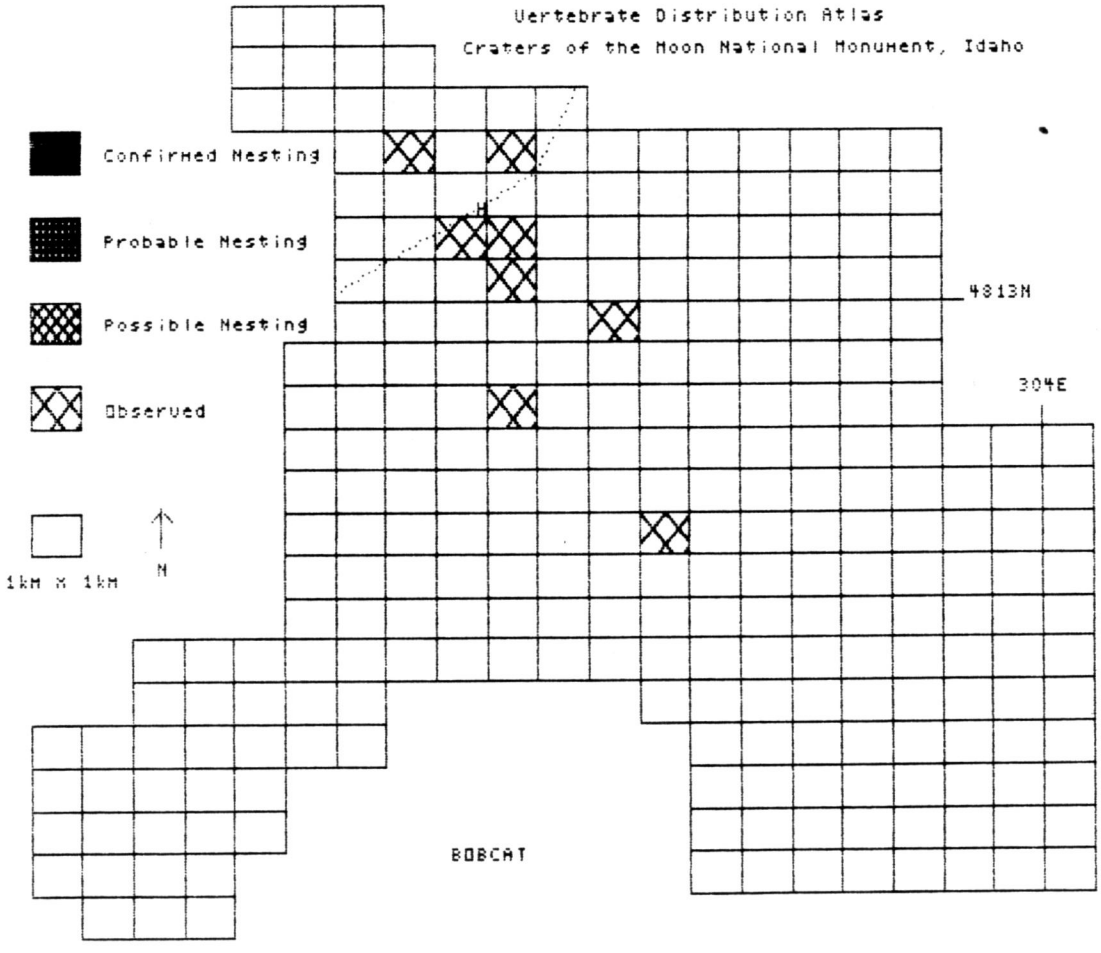

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
RACCOON

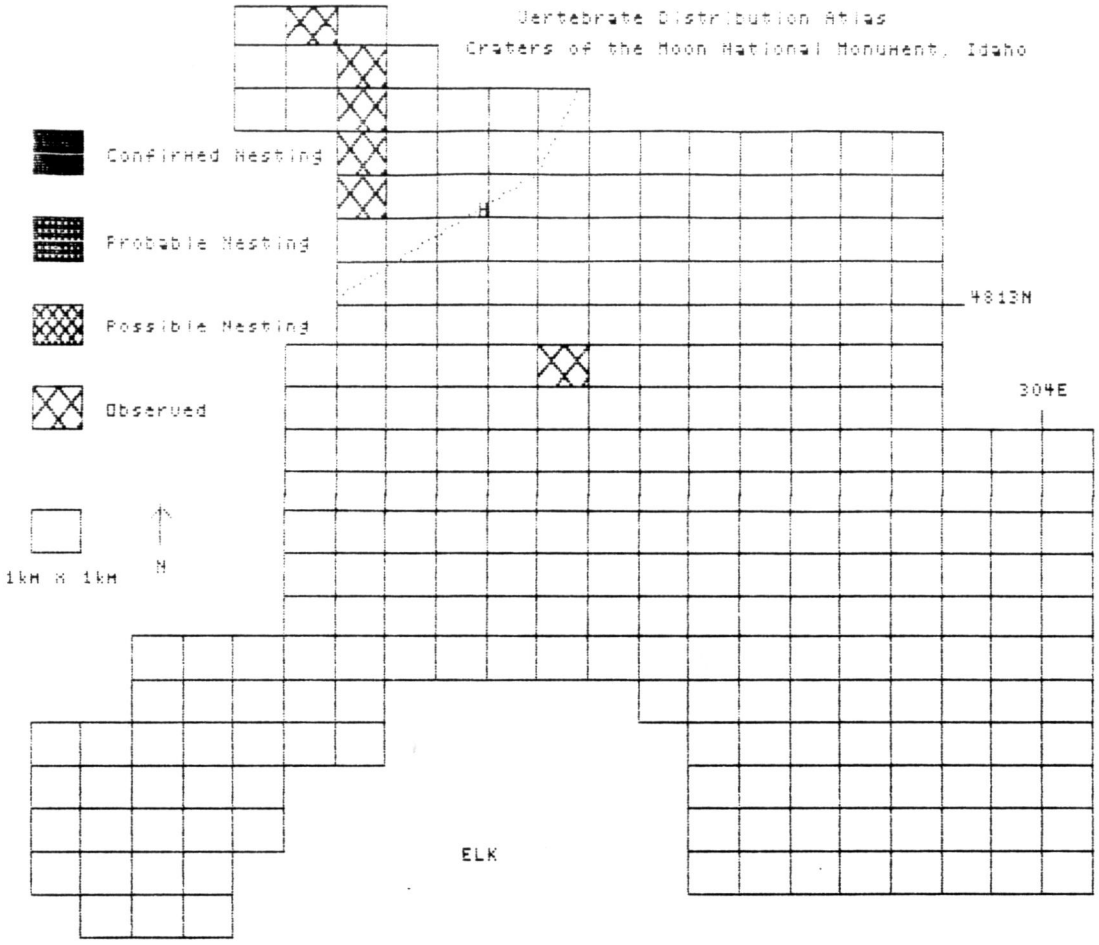

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1km x 1km
N
4813N
304E
LONG-TAILED WEASEL

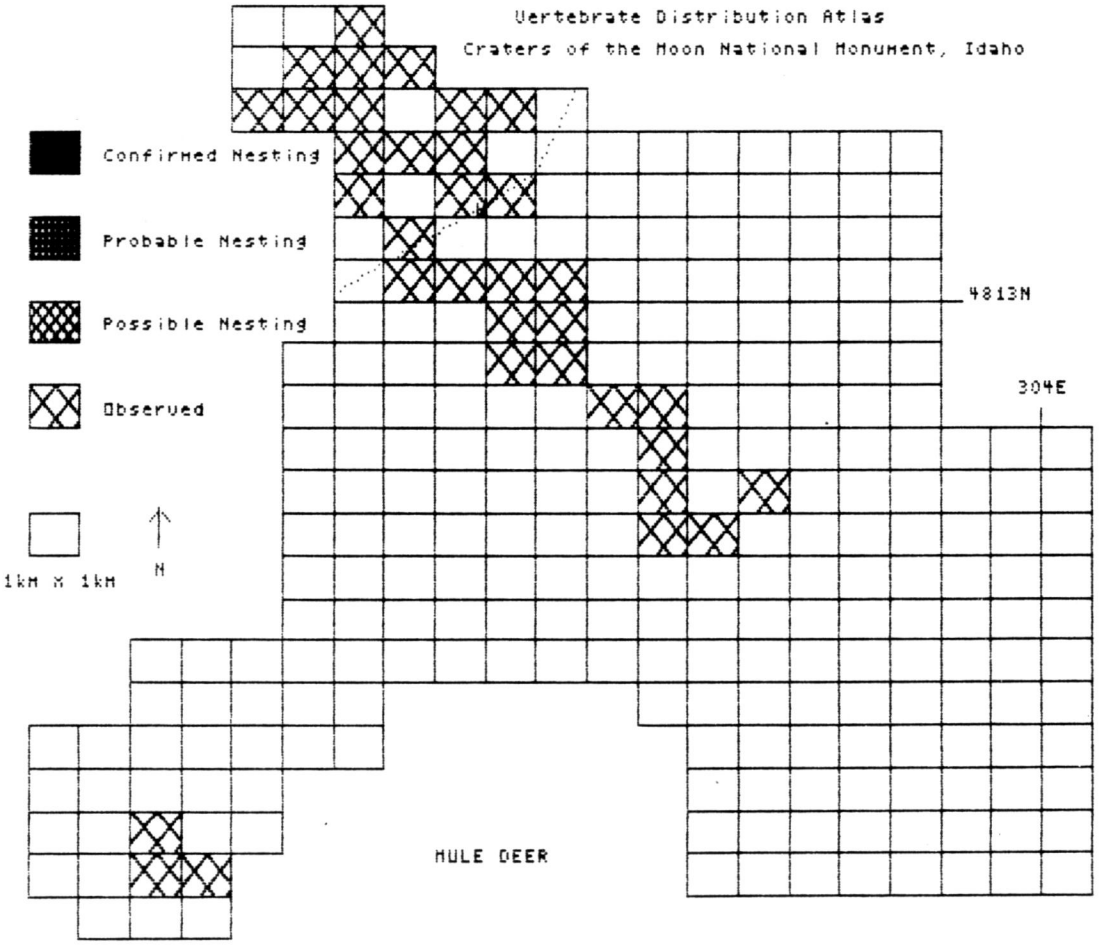

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
BADGER

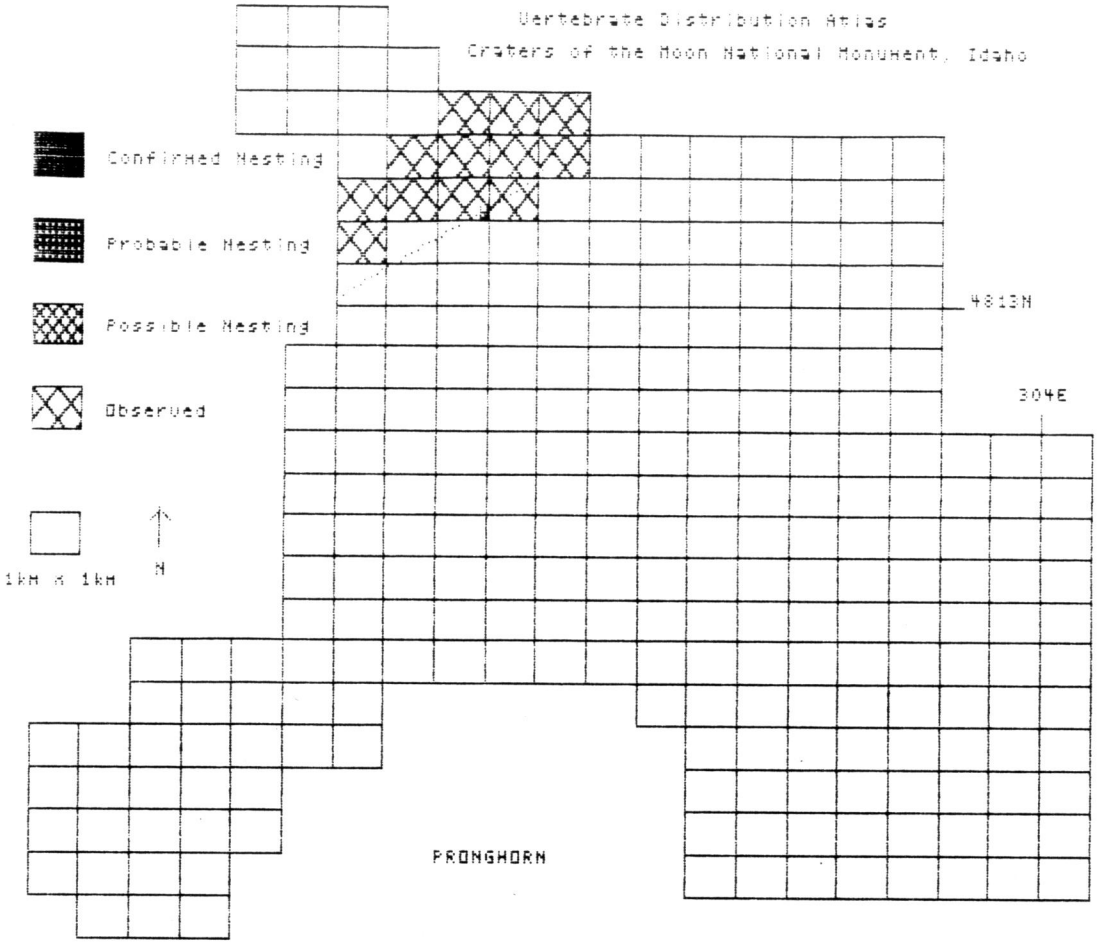

Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
STRIPED SKUNK


Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
MOUNTAIN LION


Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
BOBCAT


Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
ELK


Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
MULE DEER


Vertebrate Distribution Atlas
Craters of the Moon National Monument, Idaho
Confirmed Nesting
Probable Nesting
Possible Nesting
Observed
1kM x 1kM
N
4813N
304E
PRONGHORN

Where Tradition Meets the Future
1889-1989
University of Idaho

College of Forestry,
Wildlife and Range Sciences

Fish and Wildlife Resources
University of Idaho
Moscow, Idaho
83843

TEACHING

RESEARCH

SERVICE

October 17, 1988

Memorandum

To: Superintendent Craters of the Moon National Monument
From: Research Biologist, University of Idaho CPSU
Subject: Final reports: Baseline inventory and wildlife database

Enclosed are copies of the final report for the Craters of the Moon National Monument Wildlife Database (Report B-88-3) and for the Craters of the Moon National Monument Baseline Inventory and Monitoring Study (B-88-4). For the latter report we printed five copies with a complete appendix which contains copies of all of the vertebrate distribution maps and seasonal distributions. The remainder have been printed without these appendices. Two of the five copies are being sent to you, two will be sent to the PNRO Library and one will be retained by the CPSU.

We have appreciated the opportunity to undertake this project and hope that it will prove to be a useful component of the Monument's ecological information base.

Gerry Wright

Gerry Wright