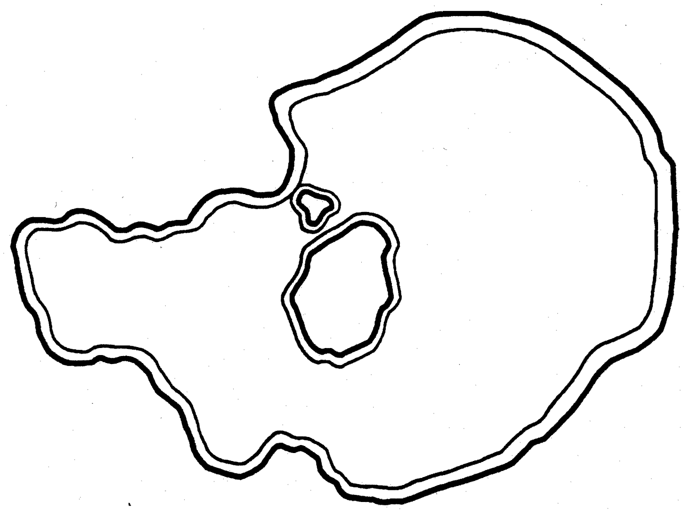
An Auxiliary Report
Prepared for the

MONO BASIN WATER RIGHTS EIR

Population Characteristics and Food Habits of Coyotes of the North-West Shore of Mono Lake, with Emphasis on Visitation to California Gull Breeding Colonies



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Mono Basin EIR Auxiliary Report No. 6

An Auxiliary Report
Prepared for the
Mono Basin Water Rights EIR Project

This auxiliary report was prepared to support the environmental impact report (EIR) on the amendment of appropriative water rights for water diversions by the City of Los Angeles Department of Water and Power (LADWP) in the Mono Lake Basin. Jones & Stokes Associates is preparing the EIR under the technical direction of the California State Water Resources Control Board (SWRCB). EIR preparation is funded by LADWP.

SWRCB is considering revisions to LADWP's appropriative water rights on four streams tributary to Mono Lake, Lee Vining Creek, Rush Creek, Parker Creek, and Walker Creek. LADWP has diverted water from these creeks since 1941 for power generation and municipal water supply. Since the diversions began, the water level in Mono Lake has fallen by 40 feet.

The Mono Basin water rights EIR examines the environmental effects of maintaining Mono Lake at various elevations and the effects of possible reduced diversions of water from Mono Basin to Owens Valley and the City of Los Angeles. Flows in the four tributary creeks to Mono Lake and water levels in Mono Lake are interrelated. SWRCB's decision on amendments to LADWP's water rights will consider both minimum streamflows to maintain fish populations in good condition and minimum lake levels to protect public trust values.

This report is one of a series of auxiliary reports for the EIR prepared by subcontractors to Jones & Stokes Associates, the EIR consultant, and contractors to LADWP. Information and data presented in these auxiliary reports are used by Jones & Stokes Associates and SWRCB, the EIR lead agency, in describing environmental conditions and conducting the impact analyses for the EIR. Information from these reports used in the EIR is subject to interpretation and integration with other information by Jones & Stokes Associates and SWRCB in preparing the EIR.

The information and conclusions presented in this auxiliary report are solely the responsibility of the author.

Copies of this auxiliary report may be obtained at the cost of reproduction by writing to Jim Canaday, Environmental Specialist, State Water Resources Control Board, Division of Water Rights, P.O. Box 2000, Sacramento, CA 95810.

POPULATION CHARACTERISTICS AND FOOD HABITS OF COYOTES OF THE NORTH-WEST SHORE OF MONO LAKE, WITH EMPHASIS ON VISITATION TO CALIFORNIA GULL BREEDING COLONIES

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Final Report to Jones and Stokes Associates

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ABSTRACT

Twelve coyotes were captured from areas proximal to traditional California Gull breeding colony sites (Negit Island) at Mono Lake, California between October 1990 and September 1991. Coyotes were fitted with activity sensitive radio collars and monitored during the Winter/Gull Arrival (Period I), Nesting/Chick Rearing (II) and Fledging/Dispersal (III) sampling periods reflected by gull behavior. Mean home range size (nearest neighbor kernel estimator, 0.001 probability contour) for territorial animals was 9.8 km^2 and was significantly smaller than that for transient animals -- 26.5 km^2. Mean size for social groups was 3.75. Population density was 0.55 coyotes per km^2, and the survival rate was 0.75. Activity schedules shifted during the study and coyote activity appeared more nocturnal during the late summer months than during the preceding sampling periods. Visitation to Negit Island varied significantly between seasons with the least visitation occurring during Period II. A group of coyotes resided on the island during and after gulls abandoned the colonies. Leporids were the source of most of the biomass ingested by coyotes during Period I (50.1%) and III (45.1%), and gulls consisted of most during Period II (41.2%). We discuss additional study objectives regarding the affects of lake level on coyotes and gull colony visitation in an addendum to the report.

INTRODUCTION

The coyote, Canis latrans, has historically increased its North American range and appears to adapt quickly to changing environments. The Mono Basin, in a flux of geologic and human perturbations, provides an ideal condition to support a healthy population of these highly adaptable carnivores. Much valuable information has been provided by various researchers in the Mono Basin, yet, as well known a role as the coyote plays in western ecosystems (Andelt 1982, Crabtree 1989, Gese et al. 1989a) this predator's role in the local ecological scheme has never been adequately defined.

This report has been compiled to describe the local coyote population and to assess their effects on the breeding success of California gulls (Larus californicus) at Mono Lake.

Study Area

The Mono Basin and its geomorphic and geohydromorphic (Stine 1988), hydrological (Vorster 1985), floral (Burch et al. 1977), entomological (Herbst 1988) and avian fauna (e.g., Jehl et al. 1984, Winkler and Shuford 1983) have been described previously. The study area encompasses the north-west shore of Mono Lake, including Negit Island and islets and is composed of approximately 94 km^2 (Figure 1). Major vegetative zones include riparian (Mill, Wilson and Decahambeau creeks), wet marsh, alkali flat, sage-brush and pinon (see Burch et al. 1977 for dominant species).

METHODS

The major aim of this study is to gather "baseline ecological data to assess the functional roles of coyotes in the immediate vicinity of Mono Lake," with a special emphasis noting their effects on the breeding success of California gulls. Therefore, the timing of data collection did not necessarily represent coyote biological periods, but coincided with major events within gull breeding colonies. Data collection periods are delineated as follows:

I **WINTER/GULL ARRIVAL:** Oct. 20, 1990 to April 23, 1991

II **NESTING/CHICK REARING:** April 23 to July 26, 1991

III **FLEDGING/DISPERSAL:** July 26 through Sept. 10, 1991

Synchronicity of gull activity is variable enough to prevent defining the categories as being mutually exclusive, but the periods capture major gull events for the 1991 season.

<u>Demographics/Activity Levels</u>

Coyote population characteristics were estimated by relying on radio telemetry, track surveys and visual and auditory observation. Animals were trapped with offset jaw, padded leg-hold traps that were fitted with tranquillizer tabs (Balser

1965). They were examined for general condition, measured and weighed. One first pre-molar was anesthetized and extracted for age determination (examination of cementum annuli sections by Matson's, Milltown, MT). Coyotes were fitted with activity-sensitive radio collars which indicated a relative state of activity or inactivity. A combination of null-peak and hand-held radio-telemetry was used to attempt to relocate all collared animals at least seven times per week. Each animal's relocations from the individual data collection periods were pooled to provide adequate sample sizes for home range size estimates. Null-peak system relocations were obtained by sequential simultaneous relocations from two fixed stations during both day and night; system error was calculated to be 1.3 degrees from reference transmitters. Hand-held relocations were only attempted during daylight hours. Fixes were taken until a sufficient number of angles produced a high degree of confidence in individual relocations; system error was calculated to be 11 degrees from reference transmitters. Given specific relocations, home ranges were mapped out using a nearest-neighbor kernel estimator (Crabtree 1989) and overlaid onto 15-minute topographical maps. Home range sizes were defined as the area within the 0.1% probability contour. Program "OVERLAP" (Crabtree 1989) provided a gage of individuals' fidelity -- i.e., a degree of similar spatial usage -- to home ranges between seasons. Animals were classified as territorial based on fidelity to non-overlapping home ranges and according to the classification criteria of Crabtree (1989). Population size was calculated as the mean number of territorial animals divided by the proportion of territorial animals in the population; density was then determined by dividing this number by the 41 km^2 portion of the study area containing the known groups.

Animals were noted as being active or inactive during regular relocations and during bimonthly over-night checks of the activity-sensitive collar transmissions. Group sizes were estimated by using opportunistic observations of socially interacting animals (e.g. traveling, hunting or group yip-howling together) and by noting mutual fidelity to nearly identical home-ranges by two or more coyotes. Dens were located and pups were counted when possible.

Island Visitation

A remote monitor placed on the Negit peninsula scanned the frequencies of all radio-collared individuals and recorded the time of presence of visiting animals on a strip chart recorder. Individuals that came within 100 meters of the west shore of Negit were monitored nearly continually. Simultaneously, we made track checks approximately three times per week to record evidence of coyotes on the land-bridge, then erased the noted trails. Weekly visitation frequencies for the radio monitor were calculated as the number of times animals appeared on the monitor per day of monitoring. Subsequent visits were only counted when separated by an hour long interval. Similarly, weekly visitation frequencies for the track check method were calculated as the number of coyote trails seen per days checked.

The sandy beaches of Twain, Java, and the Pancake peninsula were examined weekly for coyote sign by canoeing close to shore. This method was chosen to minimize disturbance to the nesting gulls which predominantly occupied the rocky beaches. Though initial checks on Negit Island were avoided to minimize disturbance to the gulls, island-wide checks were made during work and consultation with J. Dierks who was conducting observations, egg-counts, and banding (April 23, May 18-20 and July 12-14, respectively) of the California gulls for the Point Reyes Bird Observatory.

Food Habits

An extensive series of roads enabled placement of fixed scat collection routes that systematically weaved throughout the study area. Clearly defined sandy depressions on Negit Island constituted collection routes for that island. Clearing of the routes provided known-aged scats, but fresh scats were collected from all parts of the study area when found. Analysis and interpretation of scat contents was performed according to methods developed by Kelly (1991), whose model enables reporting of grams ingested, with a calculated variance, from the grams of non-assimilated food items identified in individual scats. The residue to ingestion correction factor for Leporids was that used for black-tailed jack-rabbit (Lepus californicus) and the correction factor for California Gull and Eared grebe (Podiceps nigricollis) was extrapolated from black-billed magpie (Pica

pica) using a linear regression calculated by Kelly (1991); the mean weight of gulls was estimated at 609 grams and that of grebes at 297 grams (Dunning 1984). Heads of Hyles caterpillars were assumed to represent the minimum number of caterpillars eaten and their average weight was visually estimated at four grams; the correction factor for June beetles (Polyphylla spp.) was that used by Kelly (1991) for grasshoppers (Orthoptera). Occurrence of prey items and general abundances in major habitat types were generously provided by J. Harris an M. Morrison.

An estimate of egg predation was attempted by laying out two lines of artificial gull-nests on the north-west and south-west edges of Negit and recording predations and likely culprits. Eighteen nests, each with two chicken eggs, were placed. Ten sites had no cover (> 0.3 meters to nearest vegetative or rock cover) and eight were under or nearly under shrub cover.

RESULTS

Demographics

Twelve animals (10 female, 2 male) were captured during the course of the study (Table 1). The total population of the mainland study area was estimated at 22.5 animals, of which 15 (67%) were territorial pack members. The area had a pre-whelping spring density of 0.55 coyotes per km^2. In addition, repeated visual observations and track checks indicated three animals on

Paoha Island (T. Murphy, pers. commun. 1990, J. Shivik, pers. obs. 1991).

Three coyote mortalities occurred during the study. Two were human-induced and one was the result of mountain lion (Felis concolor) predation. This resulted in a survival rate of 0.75 (SE = 0.13) for the 10 month study. In addition, two non-collared coyotes were killed by a mountain lion within the study area.

Of the sampling seasons defined, Period II (April 23 to July 26) most represents the coyote pup-rearing period. Of the three den-holes found, two had active pup sign (Dechambeau pack: six pups were whelped on or about April 10; Black Point pack: many tracks and scats). The third, Negit, was possibly a deep day bed or a den-hole of an animal that failed to successfully produce pups.

Sample sizes for individual coyote home range size estimation ranged from 43 to 160 points and had a mean of 122, which are well above the necessary samples recommended (Smith et al. 1981, Laundre and Keller 1984, Gese 1990). Eleven of twelve collared animals provided sufficient data to indicate social affiliation; six were territorial members of a social group and five were transients (Table 2).

The mean seasonal home range fidelity for territorial individuals ($\bar{x}$ = 0.56) was significantly greater (t = 4.32 P < 0.001) than that for transient individuals ($\bar{x}$ = 0.25) (Table 3).

Four territories were defined: The Danberg, Dechambeau, and Black Point packs contained four resident animals, but the North

Meadow pack was composed of three residents. Minimum mean group size was 3.75. Mean home range size for territorial animals ($\bar{x}$ = 9.8 km^2) was significantly smaller (t = 8.4 P < 0.001) than that of transients ($\bar{x}$ = 26.5km^2) for combined seasonal home ranges.

Activity Schedules

Daily activity schedules of collared coyotes shifted between seasons (Figures 2, 3 and 4). Peak activity during Period I was during the 1600-2000 interval and lowest activity was during the 0400-0800 interval. Period II peak levels were observed during 0400-0800 and lowest levels were from 1200-1600. Similarly, Period III activities shifted to represent an almost exclusively nocturnal activity cycle; activity peaked between 2000-2400 and dropped sharply during the 1200-1600 interval.

Island Visitation

Of the marked coyotes, three transient and one territorial visited the vicinity of Negit island primarily during Period III (Figure 5). Total visits of these animals are listed in Table 4. Visitation significantly varied between periods for both the remote-scanning method (H = 8.5, P = 0.015) and track survey method (F = 5.42, P = 0.01).

During April 23 and May 19 we observed high coyote activity on Negit Island. This increased amount of activity corresponded to an abrupt decline in the number of crossings over the land-bridge. To confirm our suspicions, Negit island was trapped, and coyote 170 was captured on July 3; she remained on the island until July 15, after-which coyote visitation to the vicinity of

Negit again increased. Evidence suggests that gull abandonment of the Negit colonies occurred in late May.

Food Habits

A variety of small mammal prey are vulnerable to coyote predation throughout the year in the Mono Basin (J. Harris, pers. commun. 1990). Wet meadows are occupied predominantly by voles (*Microtus spp.*); sage-brush habitats contain mostly jack-rabbits (*Lepus californicus*) then, in order of decreasing relative availability, deer mice (*Peromyscus maniculatus*), pocket mice (*Perognathus spp.*), kangaroo rats (*Dipodomys spp.*) and cotton-tails (*Sylvilagus nuttallii*). Least chipmunks (*Eutamius minimus*) also occur in lesser numbers. Negit Island supports populations of cottontails and deer mice (M. Morrison, pers. commun. 1990). However, an eruption of caterpillars (*Hyles lineata*) also occurred on Negit during June and July and provided and abundant food source for coyotes.

A total of 226 scats were collected and analyzed for study and sample sizes were 90 (Period I), 78 (Period II) and 58 (Period III). Within these respective periods, 17, 26, and 7 scats were collected from Negit. Eighteen prey categories were identified from the analysis (see Tables 5, 6 and 7). During Period I, coyotes ingested 12 types of prey (Table 5) with leporids contributing the greatest quantity of quantifiable biomass (50.1%), then gulls (19.1%), voles (14.2%) and grebes (13.3%). Period II food-habits differed (Table 6) in that the amount of gull consumed (41.2%) was greater than leporids (33.7%), and voles (19.6%) while only trace proportions of grebes were noted. A slightly larger number of items (18) were consumed by coyotes during Period III (Table 7), but relative proportions of prey biomass shifted back to more resemble Period I; leporids represented the most (45.1%), then gulls (39.3%) and voles (10.1%).

When examining Negit scat data (Table 8) with mainland scat data (Table 9), other differences are apparent. For the combined periods, leporids make up the greatest quantity of biomass consumed in scats deposited on the mainland (57.6%) and gulls represent most (73.3%) of the biomass in scats deposited on Negit.

Three adult gulls were found eaten by coyotes (May 19). One of these showed direct evidence (canine punctures and subcutaneous hemorrhaging) of being killed by a coyote on Negit. Two eggs were found that appeared to be predated upon by coyotes within the gull colony (neat, incisor-like damage to empty shell).

Of the 18 artificial nests placed, 16 were completely destroyed, one had one egg left, and one remained wholly intact. Gulls destroyed ten, and seven nest sites were damaged by undetermined causes. Two of the eight covered nests at least partly survived, none of the non-covered nests survived. The nest that remained completely intact was 1" from the crown of a rabbitbrush (Chrysothamnus spp.) plant and the nest in which only one egg was predated was completely under the crown of a rabbitbrush plant.

DISCUSSION

Demographics

In general, the coyote population of the Mono Basin exhibited characteristics similar to a light-to-moderately exploited coyote population (Crabtree 1989). The mean age of 2.64 is within the range expected for a population subjected to a 0.25 annual mortality rate. Population density and group size was similar to a shrub-steppe population studied in Washington by Crabtree (1989) and other populations with similar habitat (Andelt 1982, Gese et al. 1989b). It has been suggested by Crabtree (1989) that light-to-moderately exploited populations are made up of mostly resident animals belonging to spatially stable, contiguous, non-overlapping territories.

Indices to home range fidelity as well as home range size provided good discrimination between social class categories. The fidelity index for pack members was high and averaged 0.56 whereas the fidelity value for transients was low and averaged 0.25. The coyote 010 exhibited characteristics similar to the "floater" social class described by Beckoff and Wells (1986) and Crabtree (1989); her mean fidelity value of 0.41 is intermediate to that of territorial and transient coyotes. Opportunistic visual observations corroborated the social class designations.

Activity and Island Visitation

Shifts in activity schedules most likely reflect changes in ambient temperature during the monitoring seasons. Major prey species, such as leporids and voles are important prey sources for coyotes in the Mono Basin (see Tables 5-7) and are active at all times of day with crepuscular activity peaks. Coyotes tend to be active when their prey are most vulnerable, except when they exhibit avoidance to temperature and/or humans (Gese et al. 1989b). Incidentally, nocturnal coyotes could be expected to prey on gulls with a reduced threat of the mobbing they would suffer during the daylight hours.

A weakness in the analysis of track data exists in that only two track checks were made during the weeks of June 9 and 16. Although we doubt any unknown visitations occurred during these weeks, the ratio of tracks observed to days checked may produce a misleading, exaggerated spike in the graphically presented track data. During all other weeks, the peninsula was checked at least three times per week.

Coyote visitation to the vicinity of Negit Island varied significantly between seasons; visitation peaked before gulls nested and after they abandoned the colonies. This suggests that other factors beside gull availability are at least partly responsible for the seasonal differences in coyote visitation to Negit.

Some gaps in data collection exist -- a paucity of information regarding actual coyote activity on Negit prevents forming definite conclusions. However, at least six different adult coyotes (and we suspect eight) visited Negit during the course of the study. Two or three coyotes were resident on the island from April 23 until July 15. We strongly suspect that this group of coyotes (including radio-collared animal 170) "held" the island during this period. In addition, their presence and possibly other forms of defense kept other coyotes off Negit and probably accounted for the drop in visitation to the island during April and May. Evidence (den diggings without pup-sign, T. Murphy, pers. commun. 1991) suggests that this group may have attempted to reproduce but did not successfully produce pups. Territorial defense subsides in coyotes beginning in August (Crabtree 1989) when pups are mostly independent. This coincides with increased visitation to Negit again in August. Female 170 and presumably her group left Negit after July 15. This is approximately two months after gulls abandoned Negit.

<u>Food Habits</u>

Although large amounts of gull are evident in the diet of Negit coyotes, food sources beside gull eggs, chicks and adults are important to them. We assume that known-aged scats collected from Negit were deposited by the coyotes residing there: Crabtree (1989) found that 95% of the scats in a territory were deposited by the territorial owners, and low visitation (especially during Period II) reduces the influence of foreign coyotes in Negit scat samples. The lack of fresh water may have limited the extended stay of coyotes on Negit during late July and August, but probably does not affect them at other times of the year.

Coyotes adapt their diet to available abundant food sources. Voles, which are not present on Negit, are replaced by deer mice in the Negit scats, and birds, which seasonally are much more common then leporids, show a representative increase in coyote scats. As gulls and grebes arrive, and caterpillars peak, new abundant food sources are readily available and therefore used. Leporids, voles, and gulls are the major prey items for the Mono population and seasonal shifts in their relative consumption probably correspond to seasonal shifts and their relative abundances in the various habitat types.

In the analysis of bird prey, we calculated correction factors that were extrapolated from existing food trial data for Black-billed magpies. This may weaken conclusions concerning calculations of grams consumed. However, using magpies as a basis for the extrapolation from a linear regression of different sized mammal prey that Kelly (1991) calculated should be reliable in that Prange et al. (1979) found the relationship between avian mass and their skeletal mass was not different than that for mammals. Schmidt-Nielsen (1984) states that there are no great differences in the surface areas between birds and mammals, so the only assumption made is that coyotes eat different sized birds similarly. We believe this to be a safe assumption.

Similarly, although treatment of caterpillar and June beetle data is crude, their relative abundance in the diets of coyotes is evident.

The estimated number of grams-ingested figures that are reported are reliable for comparison, but we strongly caution the interpretation of the frequency of occurrence categories as indicative of absolute consumption (Kelly 1991). We must also note that the abundance of a food source in scats (e.g. gulls) does not necessarily translate to a predation rate on live gulls; an unknown proportion of prey consumed is undoubtedly obtained while scavenging. Coyotes do take some live gulls (see Results), but an attempt to quantify a predation rate from the amount of gull biomass consumed would be total speculation. Grebes are probably only eaten by coyotes when their carcasses wash up on beaches, but they accounted for 13.1% of consumed biomass during Period I. Therefore, a large proportion of the gulls consumed may actually be scavenged carcasses.

Too few artificial nests were placed to permit conclusions, but a lack of evidence pointing to coyote predation does not preclude their impact. Also, 25% of the covered nests at least partly survived and none of the exposed nests remained undestroyed. Certainly, more research is needed to adequately examine a possible trend.

ADDENDUM

*In addition to the objectives of the above study, JSA has requested the professional assessment of various factors related to coyote visitation. Valid conclusions cannot be made in regard to these assessments (listed below) from one year's data. Therefore, discussions of these objectives are made separately, providing little more than professional insights based on field experience and anecdotal evidence. We strongly caution reference to this material as valid conclusion, albeit it contains heuristic observations.

"Assess dynamics of cost-benefit decisions made by coyotes in considering island and islet visitation."

The large expanse of salt flat provides little, if any, barrier to coyote movements from the mainland to the Negit Island/islet area. In fact, coyotes use salt flats as foraging sites. One coyote, 010, almost exclusively uses the land-bridge that is exposed at the current lake level (See Appendix A, 010). However, it is clear that these salt flat areas are sub-optimal habitat for coyotes in that they contain little suitable habitat for coyotes or their prey.

A small moat of highly saline lake water also provides little barrier to coyotes, although it does have associated costs and provides a hinderance to some individuals: Track observations have been noted where an animal apparently walked the shoreline, stopped and headed into the Negit moat, then continued on to finally cross at the narrowest stretch of water (April 2). However, some animals are not dissuaded from crossing at a wider point: From an observation made on August 13, an animal had crossed from Negit at a wide part of the moat, where it had to swim approximately 20 meters to reach the land-bridge.

Visitation to Negit by numerous coyotes has increased the local coyote populations' information base; they have learned that Negit Island sustains both gull and non-gull food resources. This has several implications: First, it provides the coyotes with an alternative, yet profitable foraging area for times of low prey abundances/high competition elsewhere. Then, coyotes may accept a higher cost of access to Negit (i.e., longer swim at a higher lake level) to gain food because they have learned of the resource, and finally, this knowledge may reside in the local coyote population for a generation or more after a deterrent or barrier to Negit has been formed.

From heavy use of Negit and the extended period coyote 170 remained on the island after gull abandonment (see Results) we believe that neither the lack of fresh water nor the scarcity of gull prey limits a coyote's ability to survive on Negit. Other prey items are obviously present, and during periods of low ambient temperature, metabolic water may sufficiently sustain a coyote. Also, dispersal mechanisms, and not just attempts to improve foraging strategy, compel animals to seek the additional habitat that Negit (and for that matter, Paoha) provides.

Coyotes are not barred from any of the colonies, nor is their travel hindered by rough terrain (as noted by tracking an unmarked coyote through a snow-covered obsidian field on March 20). Given extended stays on Negit, and not just short visits to the island, all Negit gull colonies are equally accessible to marauding coyotes.

"Insofar as the investigations... allow, distinguish likely coyote behavior and its effects on island and islet bird populations according to lake level, determining at what lake levels gull predation or nesting disruption would possibly occur and assess likelihood of occurrence."

It is currently extremely difficult to assign visitation and disruption frequencies to any specific lake level. Other unknown factors besides ease of access may influence visitation rates. If changes in lake level cause changes in prey abundance/availability in areas adjacent to Mono Lake, coyote movement and visitation patterns may shift more than expected.

A very unique situation exists in the Mono Basin. Previous studies indicate that a wide water barrier is a deterrent to coyotes. Due to the gently sloping topography of the salt flat area between Negit and the mainland, a significant change in the cost-benefit ratio for island-visiting coyotes may occur with a relatively small change in lake level.

However, if island resources are considered desirable by an individual coyote, it will invade Negit island and islets when it is physically able to do so -- possibly at any lake level. It is important to remember that coyotes exist on Paoha, approximately 0.5 km, from land-bridged Negit. A coyote was seen en-route swimming between Paoha and Negit by T. Murphy (pers. commun. 1990).

Getz and Smith (1980) found that distances of 60 to 150 meters and water depths of 0.6 to 1 meter were required to reduce canid predation, and Giroux (1981) recommended at lest 170 meters of water approximately 0.7 meters deep. We cannot necessarily use the above barriers as a guide and hesitate to state a conjectured "magic level" at which the lake water would be sufficiently wide enough to ward away coyotes. The unique water chemistry and topography of the Mono Lake area precludes the use of previous studies for reliable inferences. An examination of the effects of various lake levels on coyote visitation to Mono Lake breeding colonies is highly warranted.

Predation of gulls will occur whenever coyotes reside on colonial islands, but the magnitude of this event remains unknown, and the relationship between coyote presence and nesting disruption <u>is not a simple cause and effect relationship</u>. Data are as yet tenuous, but occasions of coyote presence without abandonment have occurred on Twain in 1981 (Winkler 1983) and Negit in 1987 (Dierks 1988) and 1990 (Dierks 1991). Clearly, many other factors may come into play including degree and timing of coyote presence, heat, parasitism, disruption of colonies by other predators, the amount of cover in nesting areas, and the degree of physical insularization of colonies as they appear to nesting gulls. It is possible that under "stressful" low water-level conditions (non-insular and mainland-sized islands) fewer gulls will nest, and those that initiate nesting are either more apt to fail to reproduce and abandon (e.g., inexperienced breeders) and/or are more susceptible to disruption (e.g., by sustained activities of coyotes, owls, and researchers) due to low nesting densities.

"Assess possible coyote management actions identified by JSA for their ability to prevent or reduce adverse effects of coyote predation on island and islet bird populations under certain lake level alternatives."

Management actions should be dependent upon reliable information, and a logical course of action would be to more intensively investigate the relationship between coyote presence and bird reproductive failure. If healthy, large colonies are initiated on the islands, predators may be "swamped" enough to make the effect of predation on reproductive success negligible. Alternatively, if other circumstances prevent colonization or cause a weakened colony, the attempted barring of coyotes from colonial islands may be a wasted effort.

Because both gull nesting success and ease of coyote visitation are probably related to lake level, it would seem appropriate to maintain Mono Lake at a level that would support large gull colonies that could withstand less frequent coyote visitation.

Physically complicating the crossing for coyotes to Negit Island and islets may be effective for a short duration (Winkler 1980) with everything from higher fences to perpetual blasting to higher lake levels, but keeping the island coyote free for extended periods of time may prove impossible. Coyotes can learn to climb fences, jump over electric fences (T. Murphy, pers. commun. 1990) and swim long distances. Should the health of the gull population be stressed over that of the coyote population, some common control actions (e.g., destroying resident coyotes) may temporarily limit coyote presence on the islands. However, the response of coyote populations to past North American control methods indicates that many control efforts would be neither biologically nor economically effective for the local population in the long term.

TABLE 1. General characteristics of captured Mono Basin coyotes.

Animal	Sex	Age	Capture date	Weight(kg)
010	F	1	10-25-90	7.3
030	M	1	11-17-90	10.4
050	F	>5	11-02-91	11.1
110a*	M	<1	11-12-91	8.2
110b	F	1	02-19-91	10.9
130a*	F	4	10-20-90	10.0
130b	F	--	03-13-91	9.1
170a*	F	<1	10-19-91	7.3
170b	F	<1	07-03-91	9.8
188	F	4	11-05-91	11.3
350	F	4	11-08-91	9.8
373	F	1	11-10-91	9.7
		$\bar{X} = 2.6$		$\bar{X} = 9.6$

*Winter mortality

TABLE 2. Social and spatial characteristics of Mono Basin coyotes.

Animal	Home range (km^2)	Mean fidelity index	Social status	Area used
010	30.7	.39	Transient	Negit/salt
030	11.8	.40	Territorial	Black Pt.
050	21.1	.23	Transient	Study area
110a*	---	---	Unknown	Unknown
110b	7.5	.49	Territorial	Danberg
130a*	---	---	Territorial	Dechambeau
130b	9.7	.49	Territorial	Dechambeau
170a*	---	---	Territorial	Dechambeau
170b	25.1	.10	Transient	Negit
188	10.1	.63	Territorial	Danberg
350	27.7	.16	Transient	Study area
373	28.0	.13	Transient	Bodie Rd.

*Winter mortality.

Table 3. Seasonal home-range fidelity for Mono Basin coyotes (750 meter resolution).

	Overlap between periods			
Animal	I and II	II and III	I and III	
010	.35	.46	.36	
050	.26	.26	.19	transients
170b	---	.10	---	$\bar{x}$ = .25
350	.16	.18	.14	
373	.19	.14	.05	
030	.43	.32	.45	
110b	.46	.60	.41	territorials
130b	.39	.67	.40	$\bar{x}$ = .56
188	.62	.73	.54	

Table 4. Number of visits of radio-marked coyotes to within 100m of Negit Island.

Animal	Period I	Period II	Period III
010	1*	1	27
050	0	0	6
350	0	0	7
030	0	0	2
170	--	1#	1

*010 originally captured on Negit and later observed there, these values only include visits recorded by the island radio monitor.

#170 captured on Negit on July 3, and remained there until July 15.

Table 5. Food habits of Mono Basin coyotes, Period I.

Species consumed	g. ingested-single (95% bound)	g. ingested-mixed (95%)	Total	% of total ingested
Leporid	11685.1(2844)	3248.4(894)	14933.5	50.1
Microtus	3245.1(1234)	973.7(272)	4218.8	14.2
Peromyscus	407.1(318)	---	407.1	1.4
Reithronomys	118.7(236)	15.1(30)	133.8	0.5
Microdipodops	328.4(652)	---	328.4	1.1
Dipodomys	16.7(23)	---	16.7	<0.1
Gull	5676.0	---	5676.0	19.1
Grebe	3948.9	---	3948.9	13.3
Caterpillar	8.0	---	8.0	<0.1
Beetle	0.1(.1)	---	0.1	<0.1
Unk. Bird			9 scats	
Egg			0 scats	
Unk rodent			0 scats	
Vegetation			4 scats	
Deer			0 scats	
Fox			0 scats	
Coyote			0 scats	
Garbage			0 scats	
			29671.3grams/90scats	

Table 6. Food habits of Mono Basin coyotes, Period II.

Species consumed	g. ingested-single (95% bound)	g. ingested-mixed (95%)	Total	% of total ingested
Leporid	3659.1(1598)	2858.9(930)	7874.6	33.7
		1356.6(1781)		
Microtus	4312.1(1505)	227.4(112)	4589.6	19.6
		50.1(97)		
Peromyscus	385.8(276)	116.8(103)	502.6	2.1
Reithronomys	23.7(47)	5.8(11)	29.5	0.1
Microdipodops	---	---	---	0.0
Dipodomys	64.3(128)	33.3(64)	242.9	1.0
		145.3(192)		
Gull	9645.4	---	9645.4	41.2
Grebe	0.1	---	0.1	<0.1
Caterpillar	496.0	---	496.0	2.1
Beetle	18.9(16)	---	18.9	<0.1
Unk. Bird			3 scats	
Egg			5 scats	
Unk rodent			1 scats	
Vegetation			3 scats	
Deer			0 scats	
Fox			0 scats	
Coyote			0 scats	
Garbage			1 scats	
			23399.5grams/78scats	

Table 7. Food habits of Mono Basin coyotes, Period III.

Species consumed	g. ingested-single (95% bound)	g. ingested-mixed (95%)	Total	% of total ingested
Leporid	3988.6(1273)	575.1(358)	6430.2	45.1
		1866.5(2317)		
Microtus	1432.1(765)	___	1432.1	10.1
Peromyscus	256.4(197)	43.0(81)	299.4	2.1
Reithronomys	308.6(428)	<0.1	308.6	2.2
Microdipodops		40.5(76)	40.5	0.3
Dipodomys	76.2(151)	40.9(53)	46.1	0.3
		5.2(7)		
Gull	5602.8	---	5602.8	39.3
Grebe	13.2	---	13.2	0.1
Caterpillar	92.0	---	92.0	0.6
Beetle	167.2(143)	---	167.2	1.2
Unk. Bird			2 scats	
Egg			1 scat	
Unk rodent			1 scat	
Vegetation			4 scats	
Deer			1 scat	
Fox			1 scat	
Coyote			1 scats	
Garbage			1 scats	

14264.9grams/58scats

Table 8. Food habits represented by Negit scats.

Species consumed	g. ingested- single (95% bound)	g. ingested- mixed (95%)	Total	% of total ingested
Leporid	1382.3(1329)	352.2(494)	1734.5	8.8
Microtus	799.1(896)	19.6(27)	818.7	4.1
Peromyscus	1165.1(589)	---	1165.1	5.9
Dipodomys	0.5(0.9)	---	0.5	<0.1
Gull	14400.9(5265)	---	14400.9	73.3
Grebe	1059.8	---	1059.8	5.3
Caterpillar	588.0	---	588.0	3.0
Beetle	5.7(3.7)	---	5.7	<0.1
Unk. Bird			10 scats	
Egg			6 scats	
Unk rodent			0 scats	
Vegetation			4 scats	
Deer			0 scats	
Fox			0 scats	
Coyote			0 scats	
Garbage			2 scats	

19773.2grams/50scats

Table 9. Comparison of prey proportions in mainland and Negit Island scats.

Prey	Percent of Total Biomass: Mainland	Percent of Total Biomass: Negit
Leporid	57.6	8.8
Microtus	19.7	4.1
Peromyscus	0.1	5.9
Reithronomys	1.0	<0.1
Microdipodops	0.8	0.0
Dipodomys	0.6	0.0
Gull	13.7	73.3
Grebe	6.1	5.4
Caterpillar	<0.1	3.0
Beetle	0.4	<0.1

Figure 1. Mono Basin Coyote Project study area.

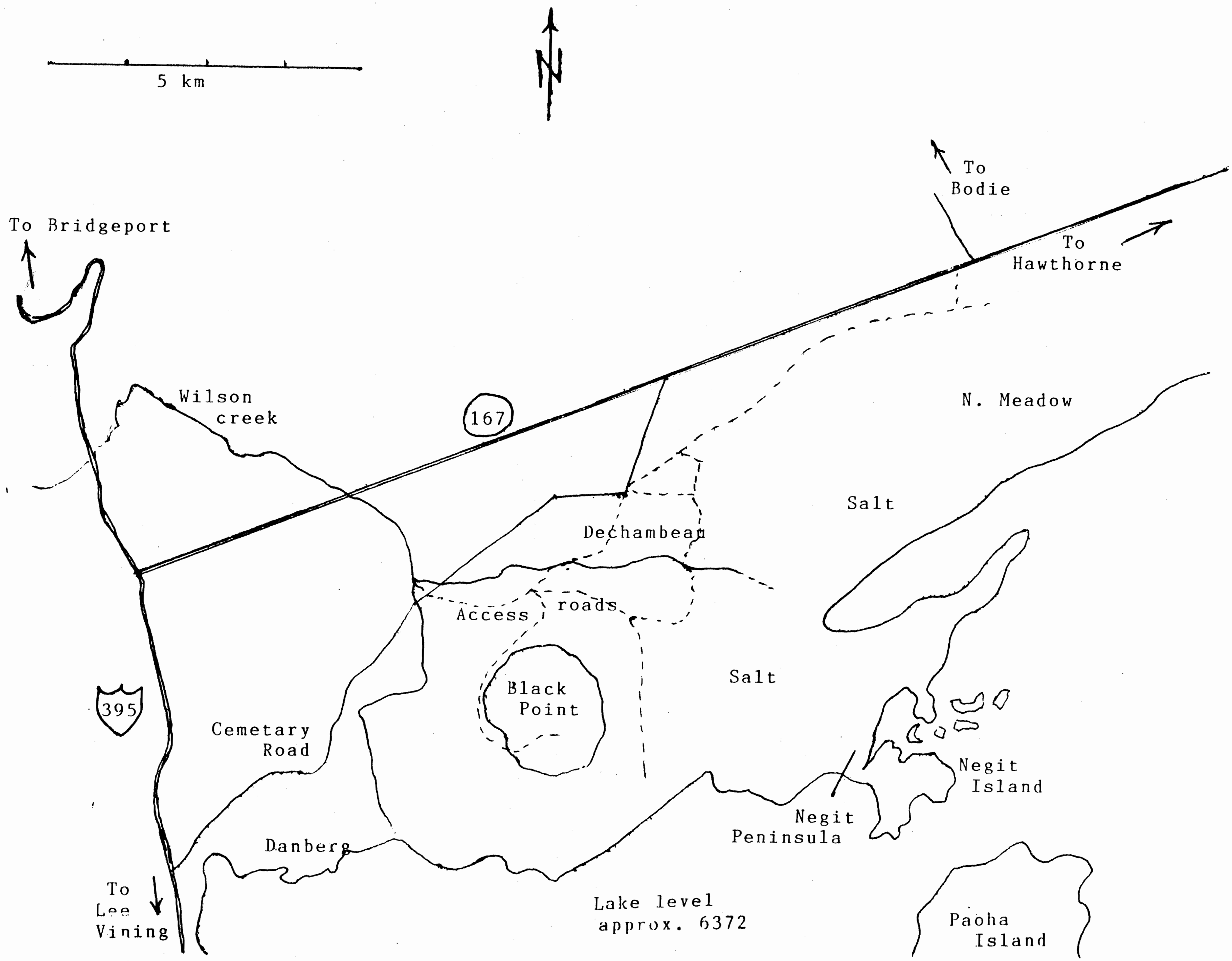


Figure 2. Activity Levels, Period I

October 20, 1990 through April 23, 1991

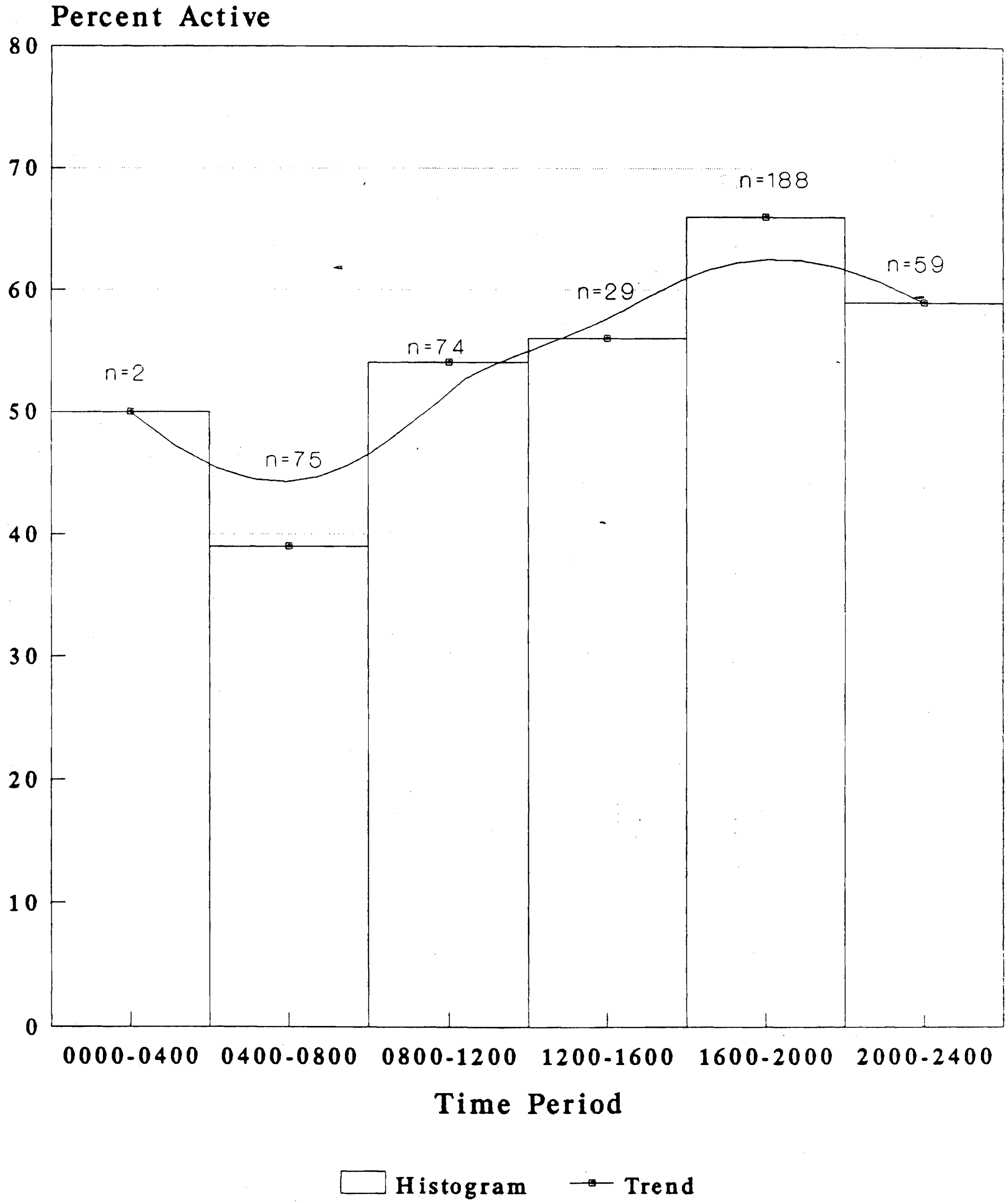


Figure 3. Activity Levels, Period II

April 23 through July 26, 1991

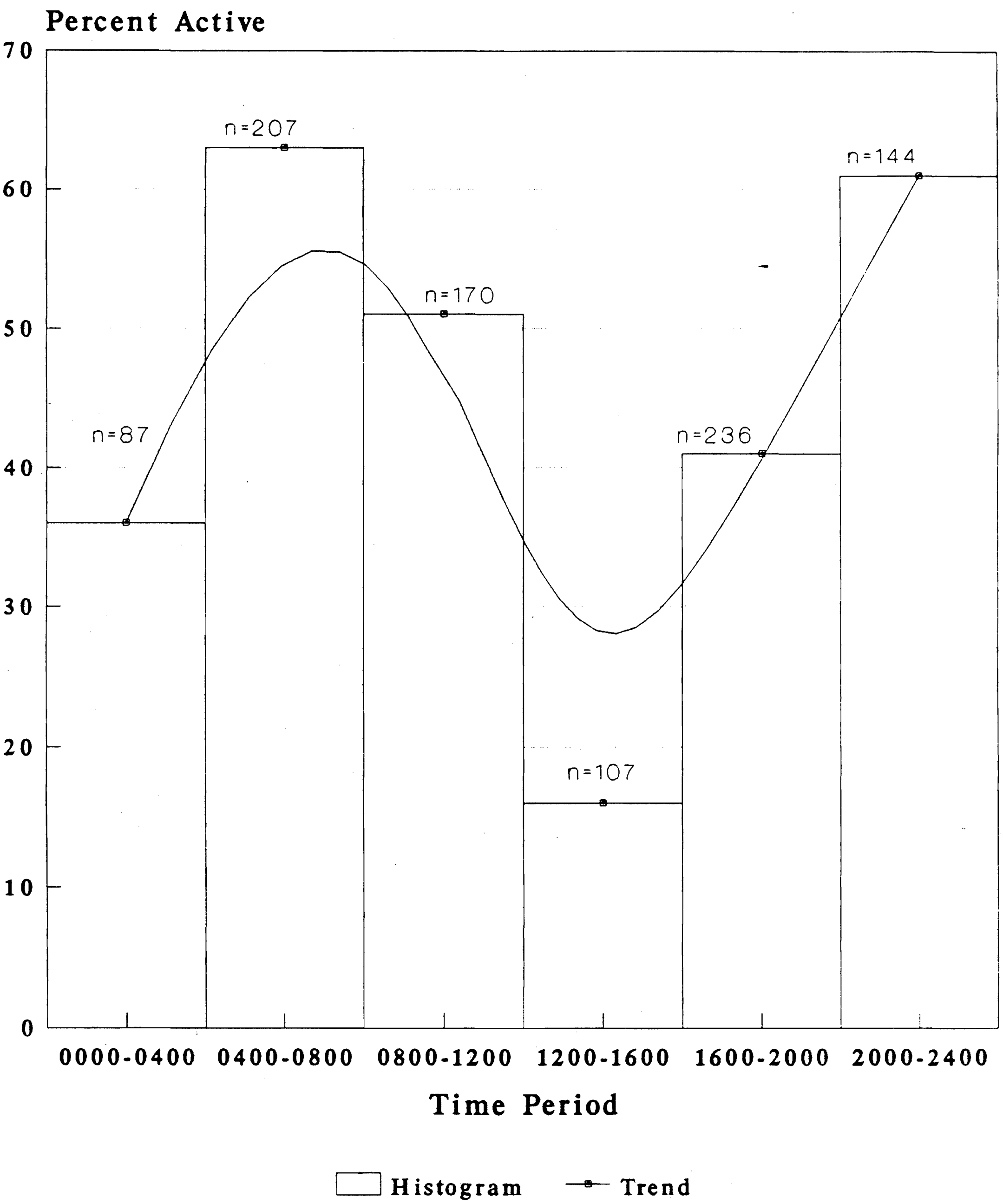


Figure 4. Activity Levels, Period III

July 26 through September 10, 1991

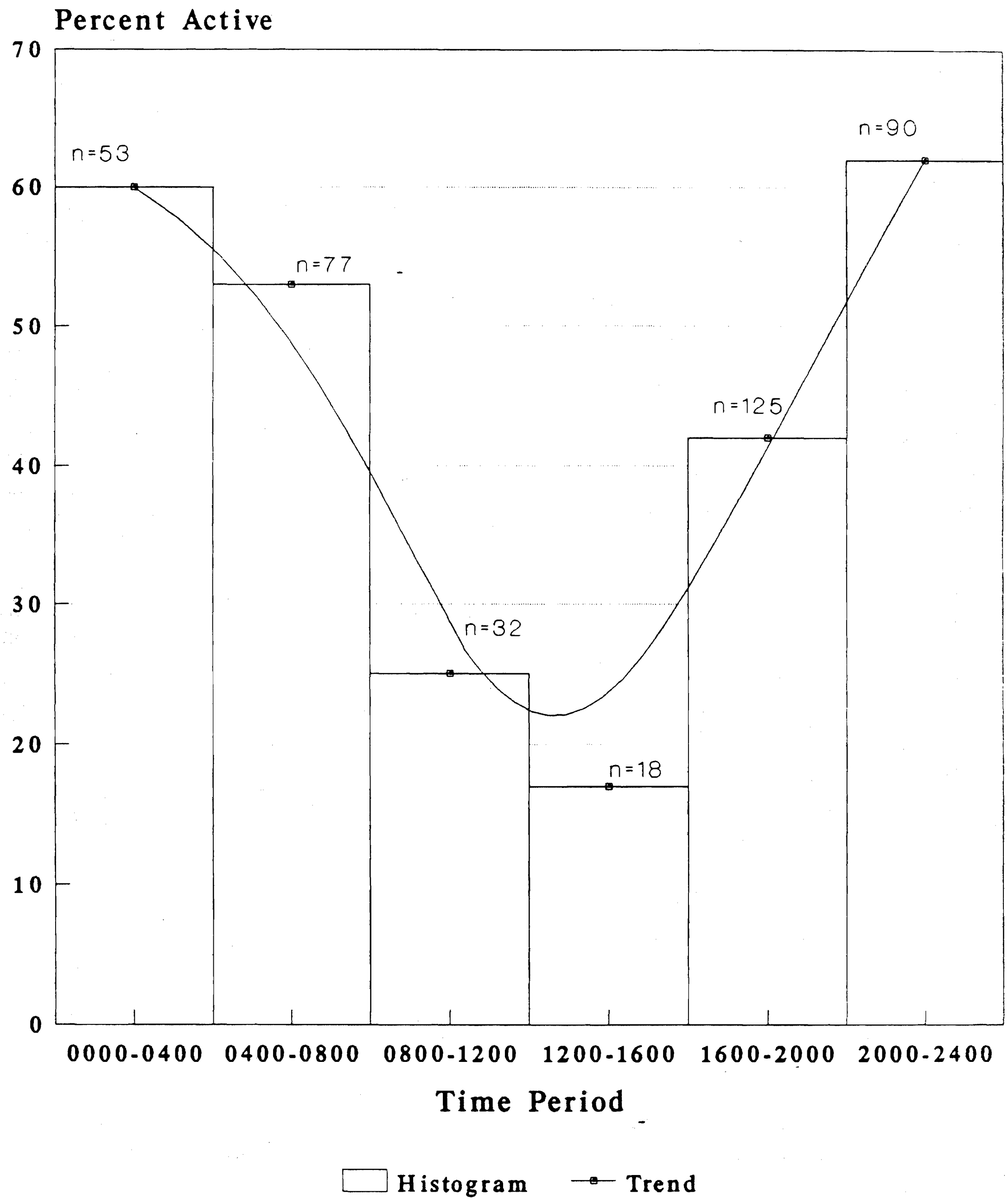
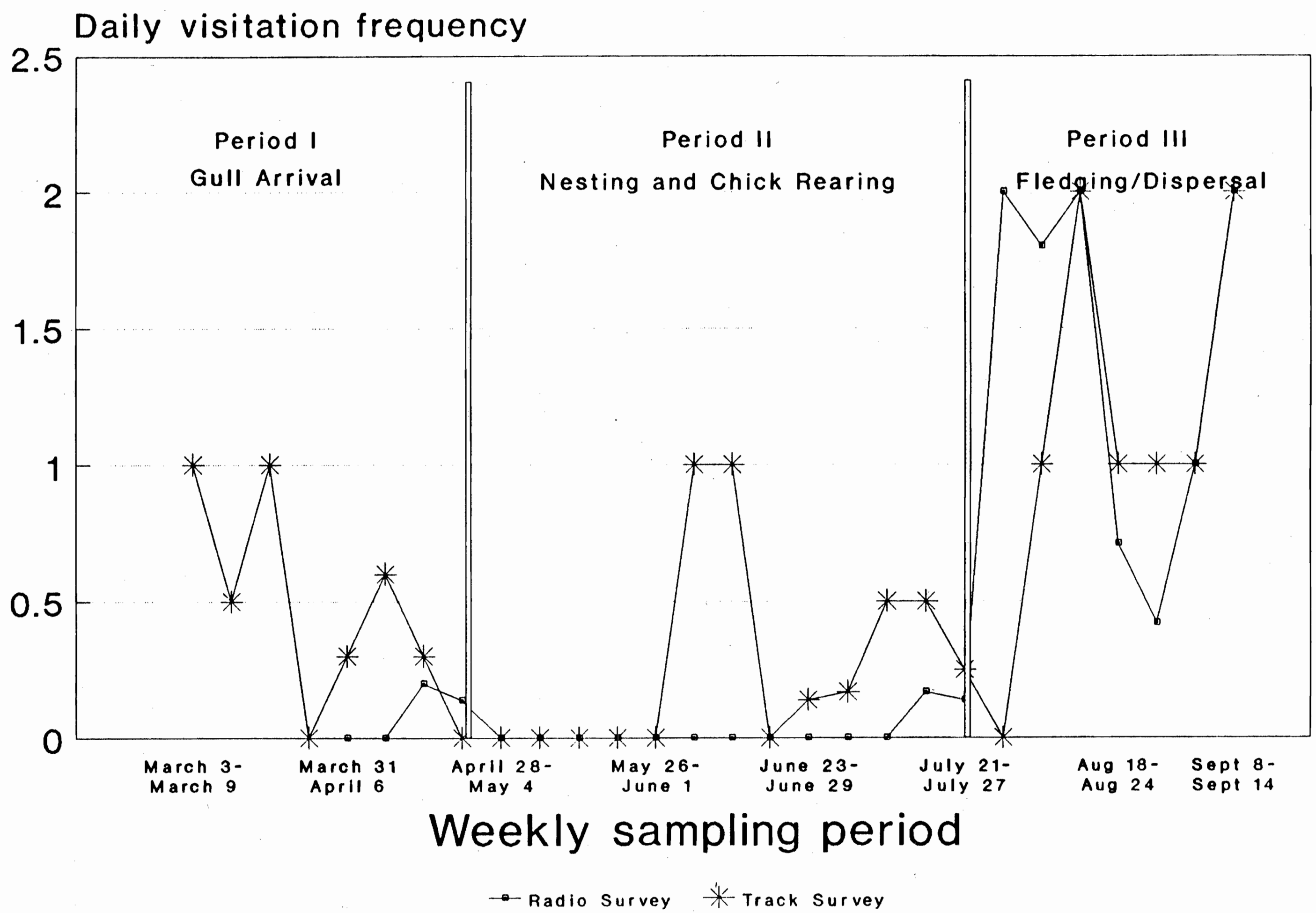


Figure 5. Daily visitation frequencies of coyotes to Negit Island.



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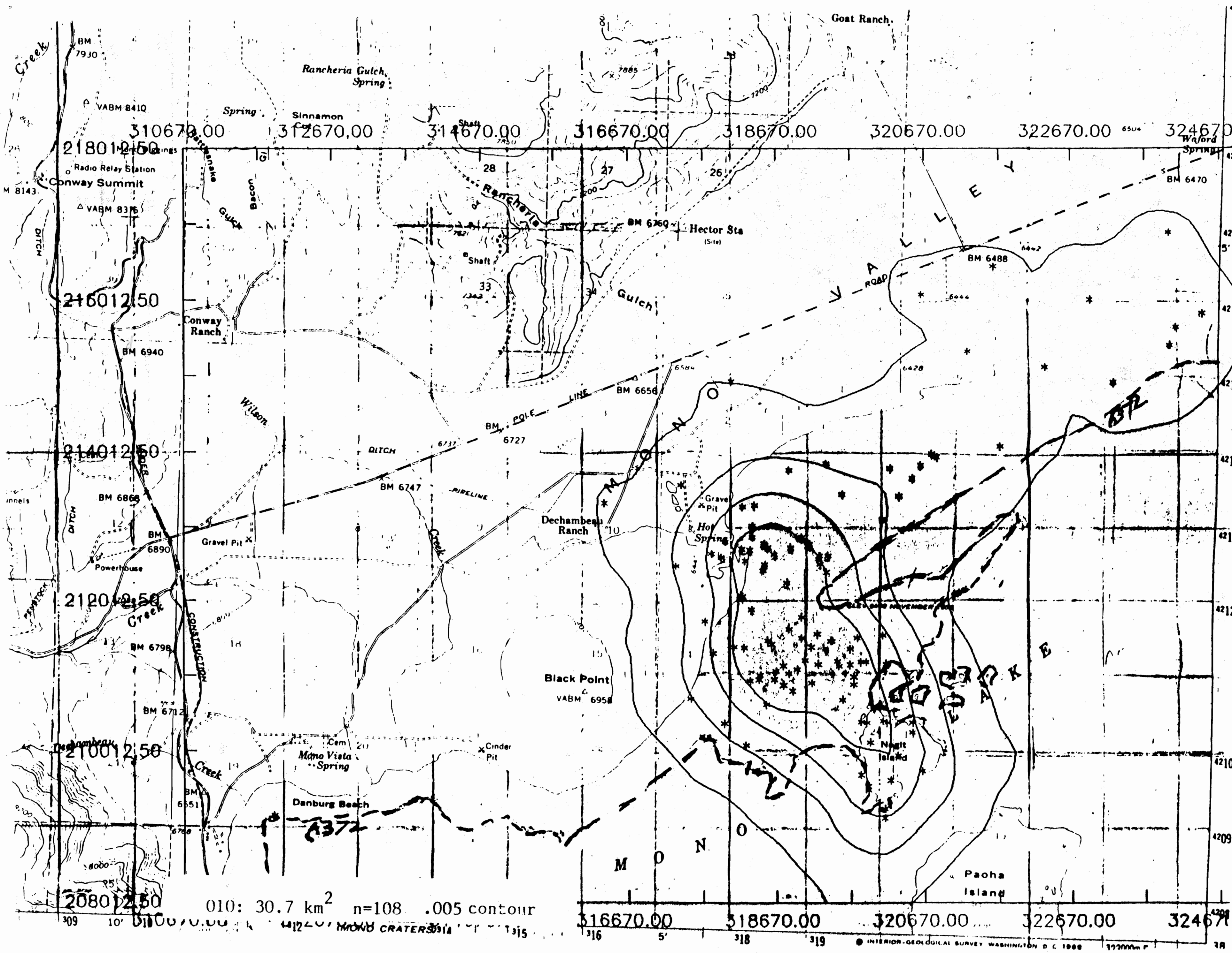
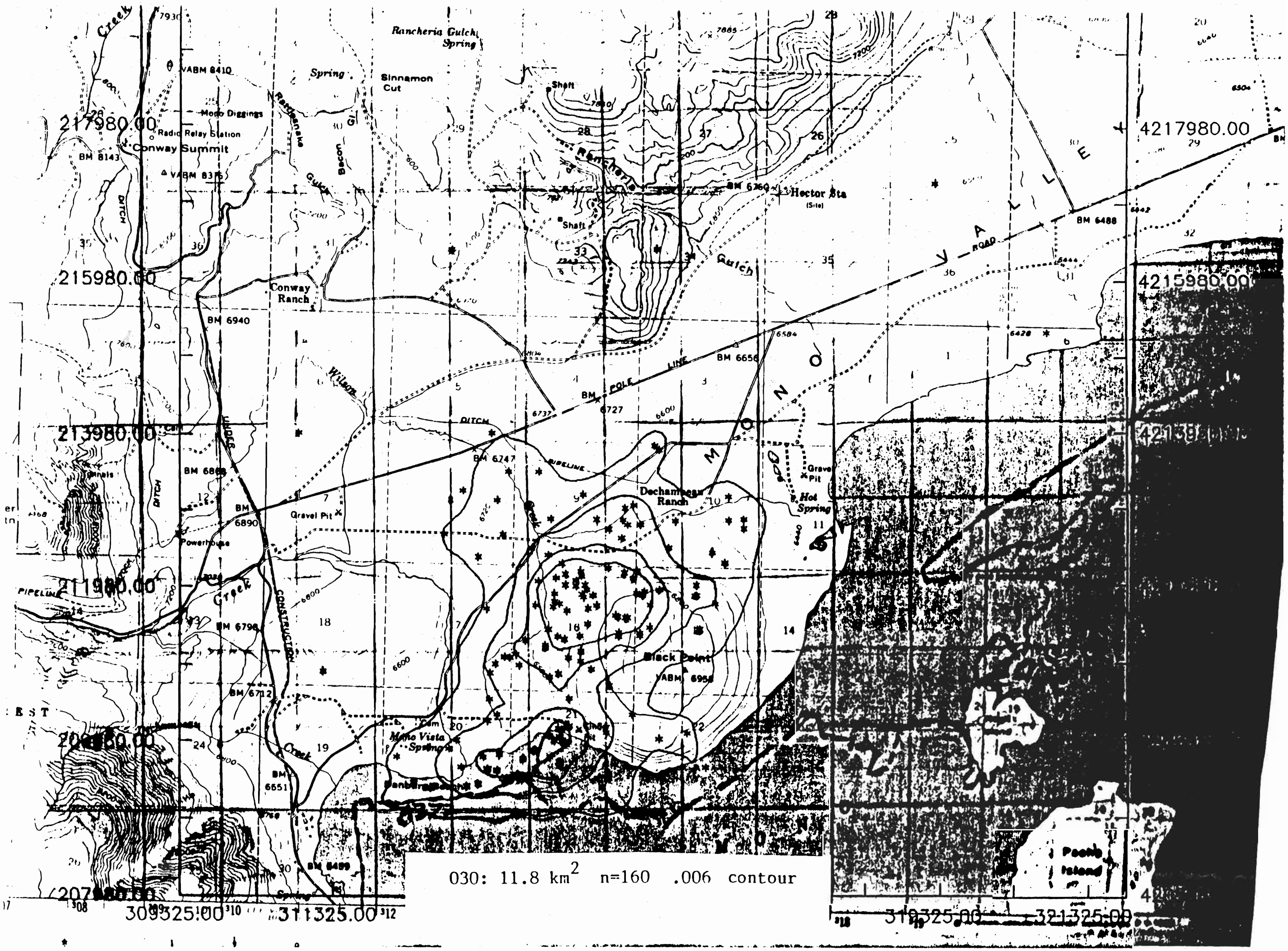
Appendix A:

Coyote home-ranges overlayed onto 15min. maps.

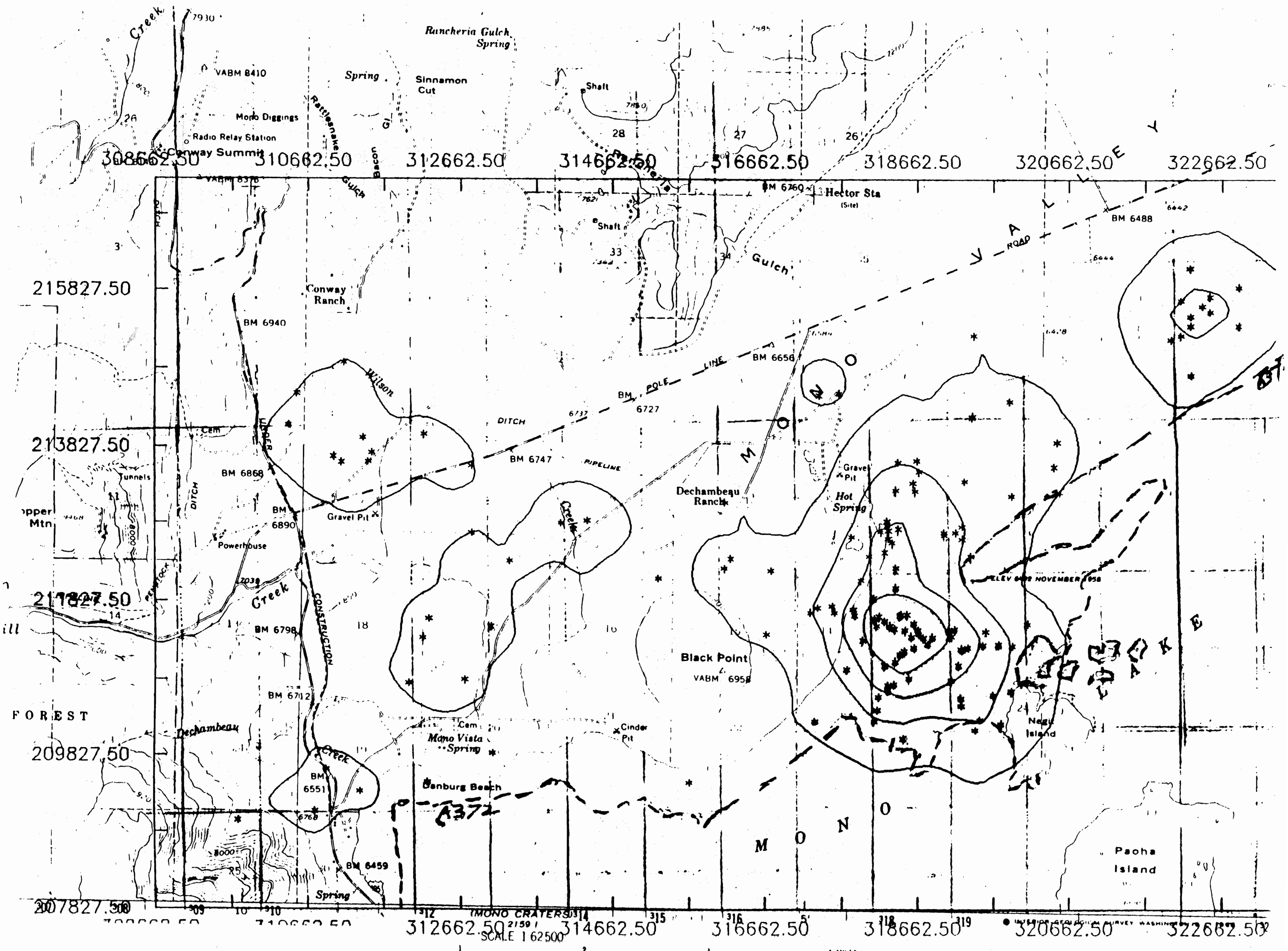
Probability contours begin at the 0.001 level and increase as indicated. Home range sizes are the area within the outermost (0.001) contour.



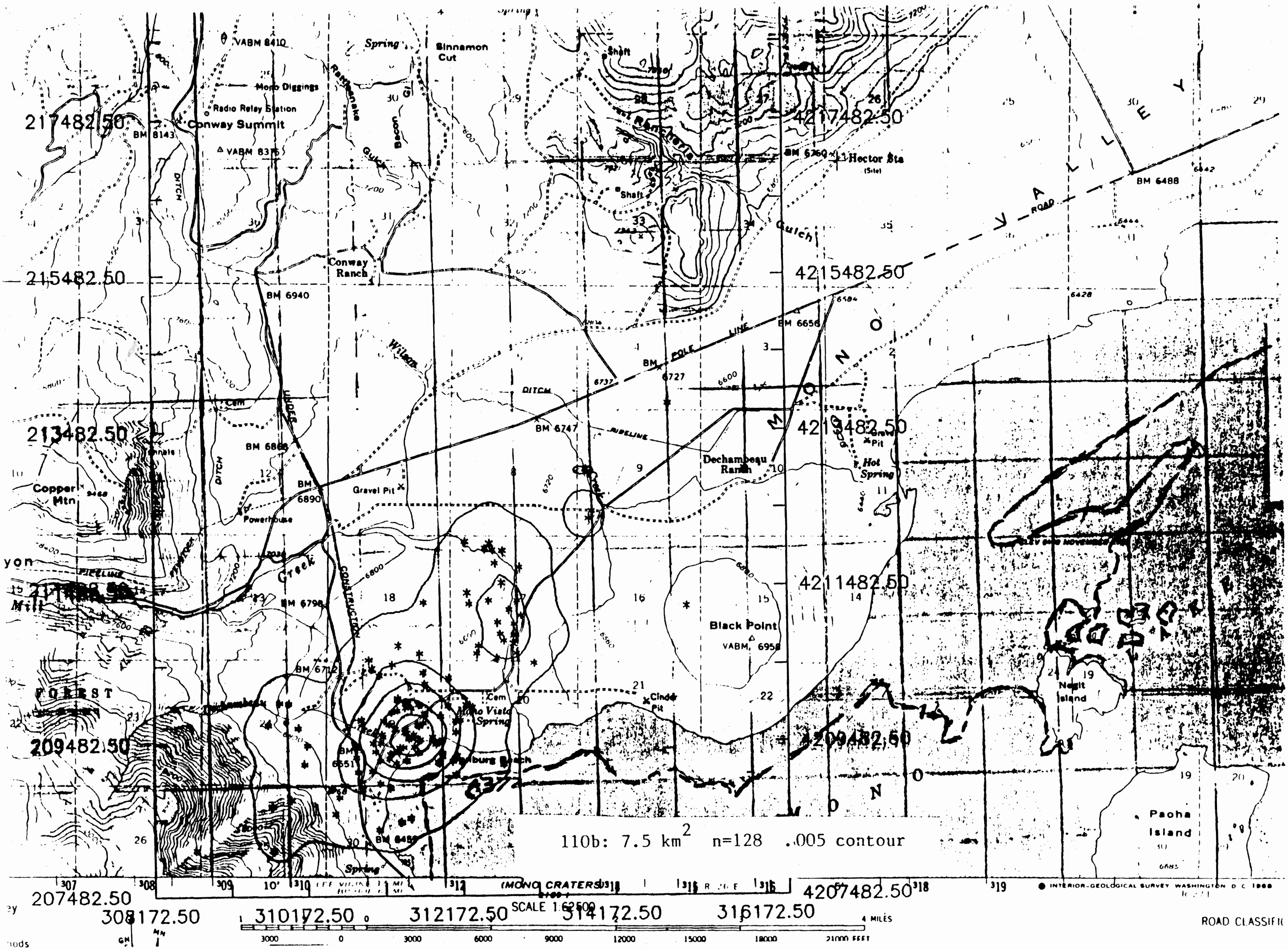
010: 30.7 km^2 n=108 .005 contour



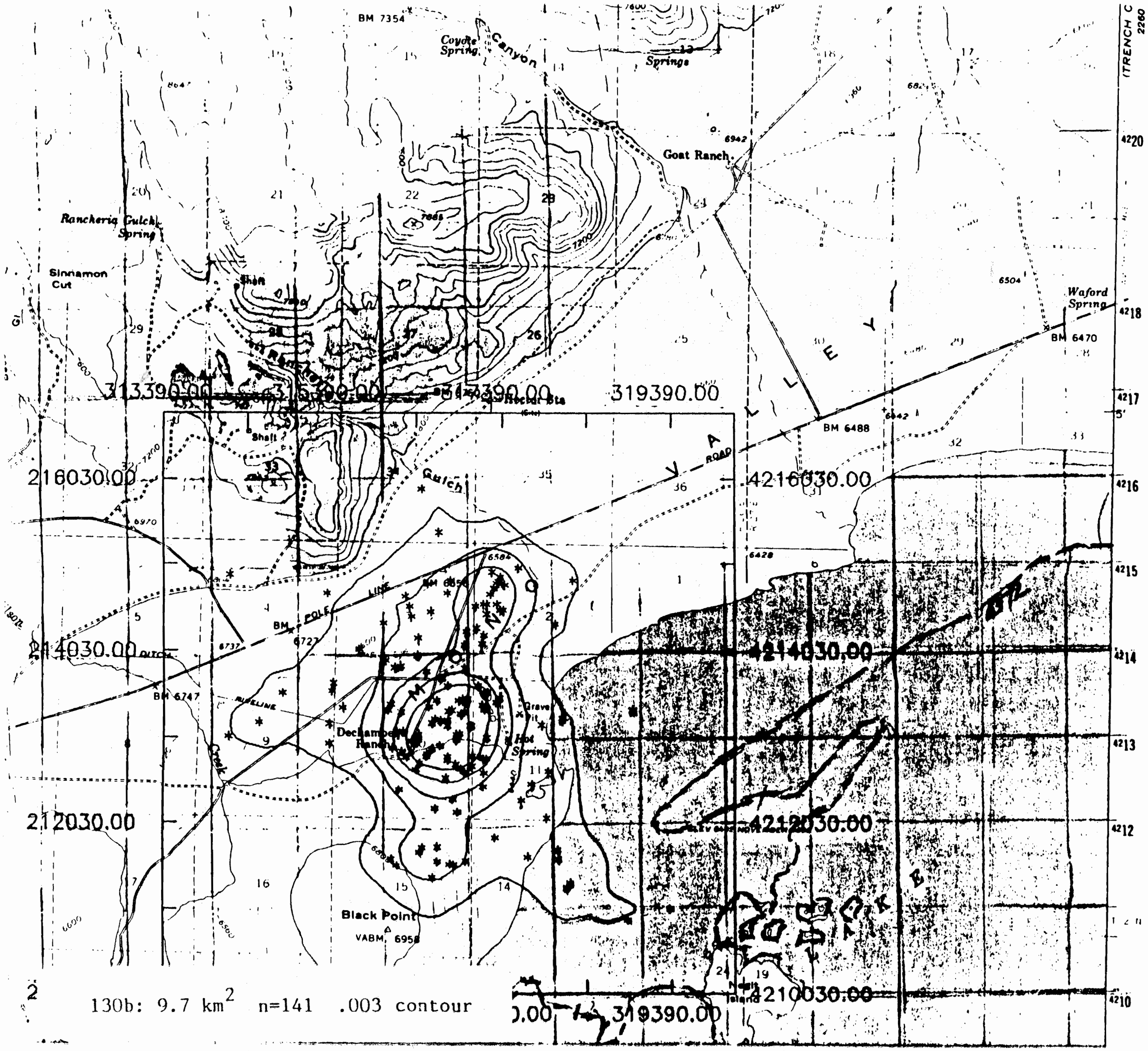
030: 11.8 km^2 n=160 .006 contour



050: 21.1 km^2 n=142 .004 contour

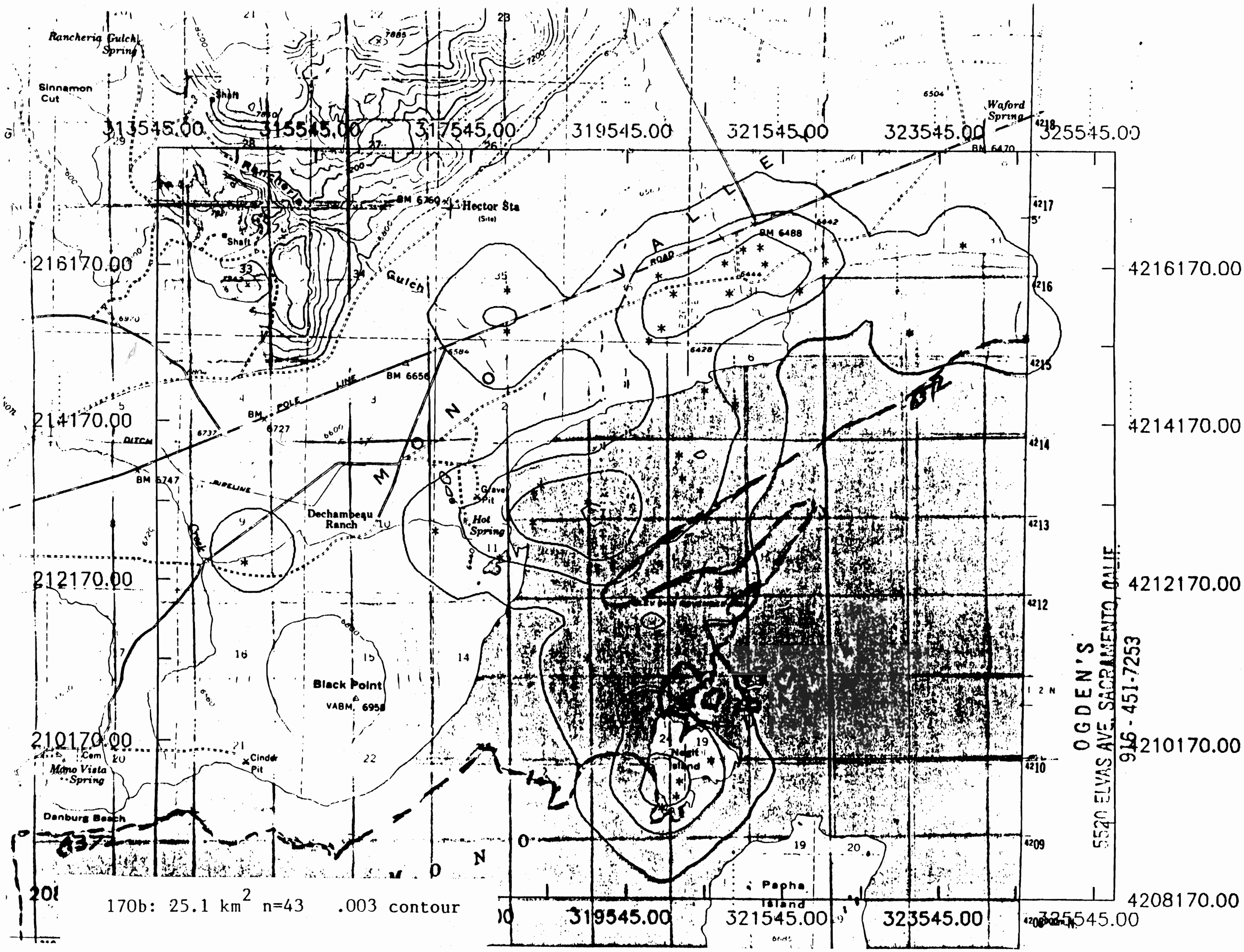


110b: 7.5 km^2 n=128 .005 contour

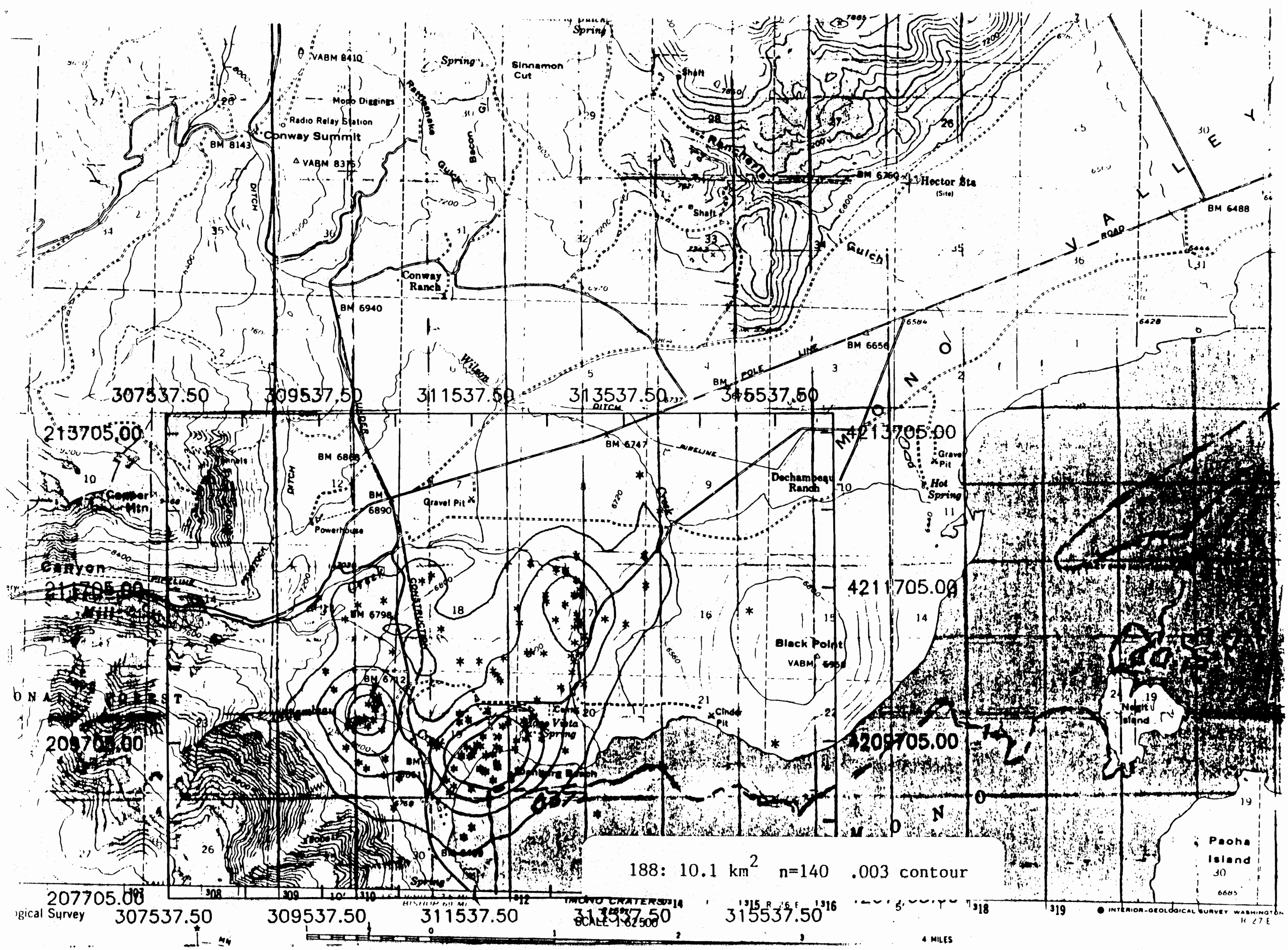


2

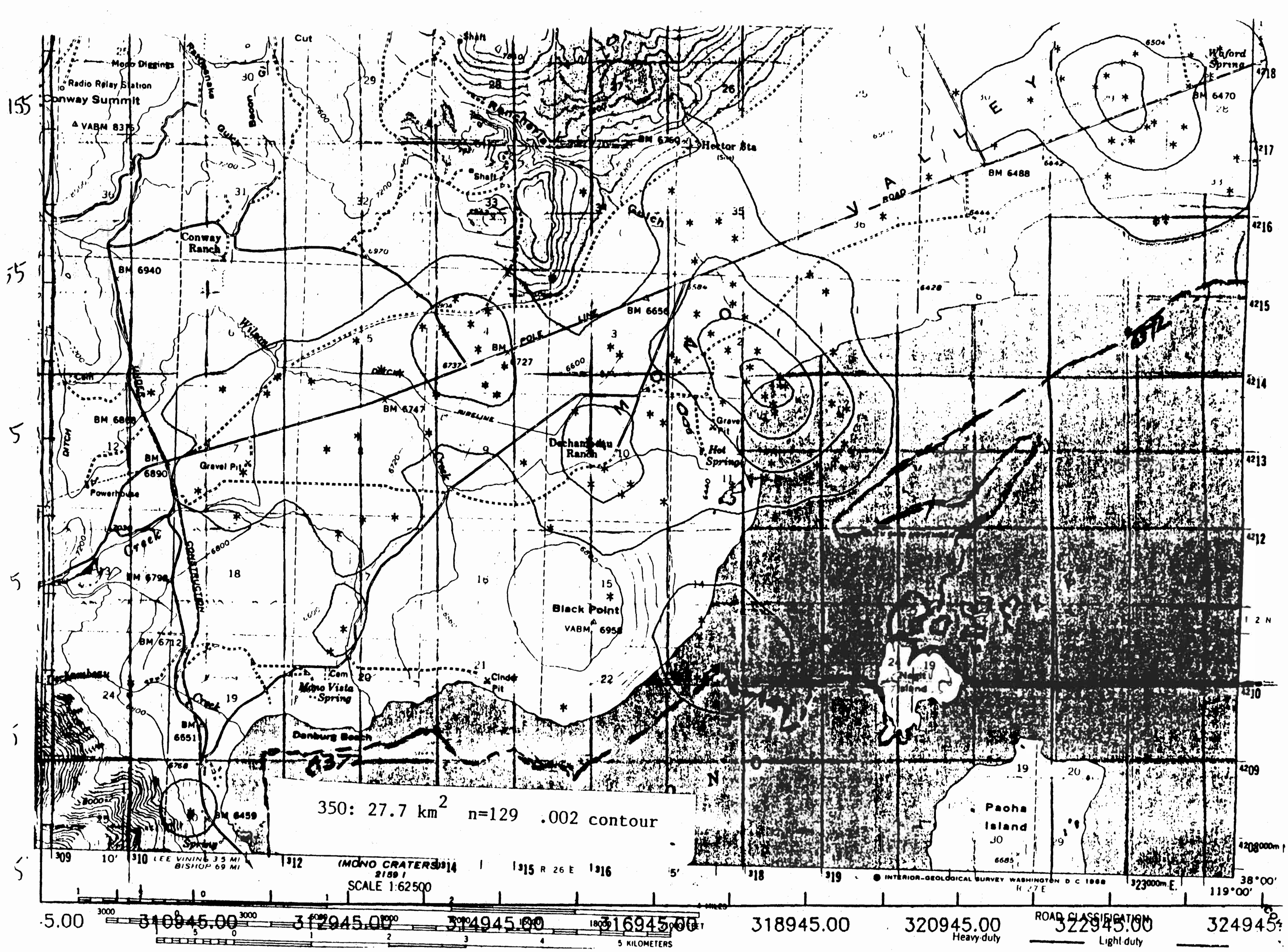
130b: 9.7 km^2 n=141 .003 contour



170b: 25.1 km^2 n=43 .003 contour



188: 10.1 km^2 n=140 .003 contour



350: 27.7 km2 n=129 .002 contour
Conway Summit
Radio Relay Station
Mono Diggings
Conway Ranch
Dechambeau Ranch
Black Point
Hot Spring
Mono Vista Spring
Danburg Beach
Paoha Island
Wilson Creek
Hector Sta
Wilford Spring
(MONO CRATERS)
SCALE 1:62500
5 KILOMETERS
ROAD CLASSIFICATION
Heavy-duty
Light-duty
INTERIOR-GEOLOGICAL SURVEY WASHINGTON D C 1968
LEE VINING 3.5 MI
BISHOP 69 MI
38°00'
119°00'
310945.00
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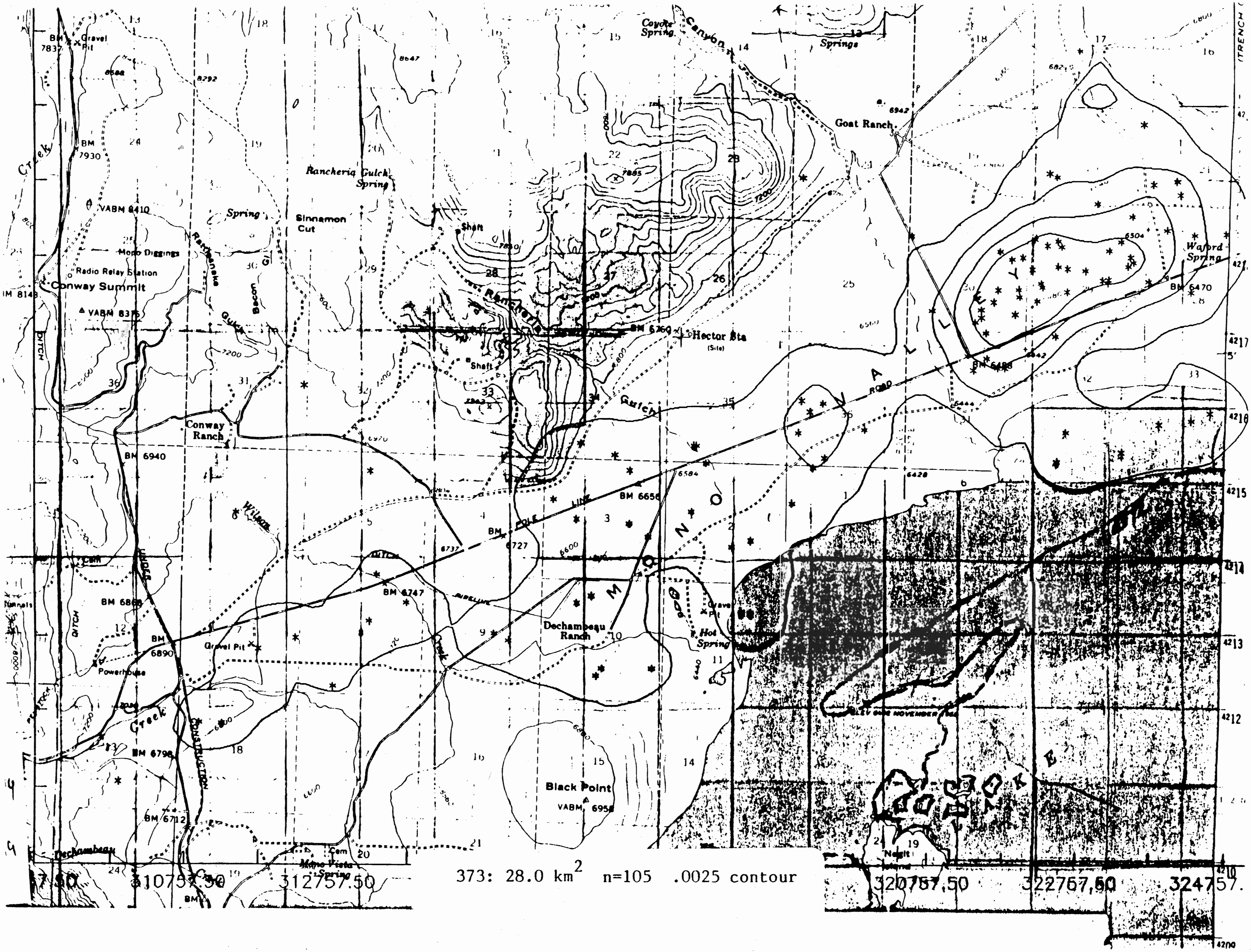
320945.00
322945.00



373: 28.0 km^2 n=105 .0025 contour