CASA DIABLO GEOTHERMAL DEVELOPMENT PROJECT:

DEER MIGRATION STUDY, SPRING 1988

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and marked into 29 sections each 0.1 miles long except Section 1, which was 0.2 miles long. Sections 1 through 20 are identical to those of last year's study; sections 21 through 29 were not included in the surveys done last year.

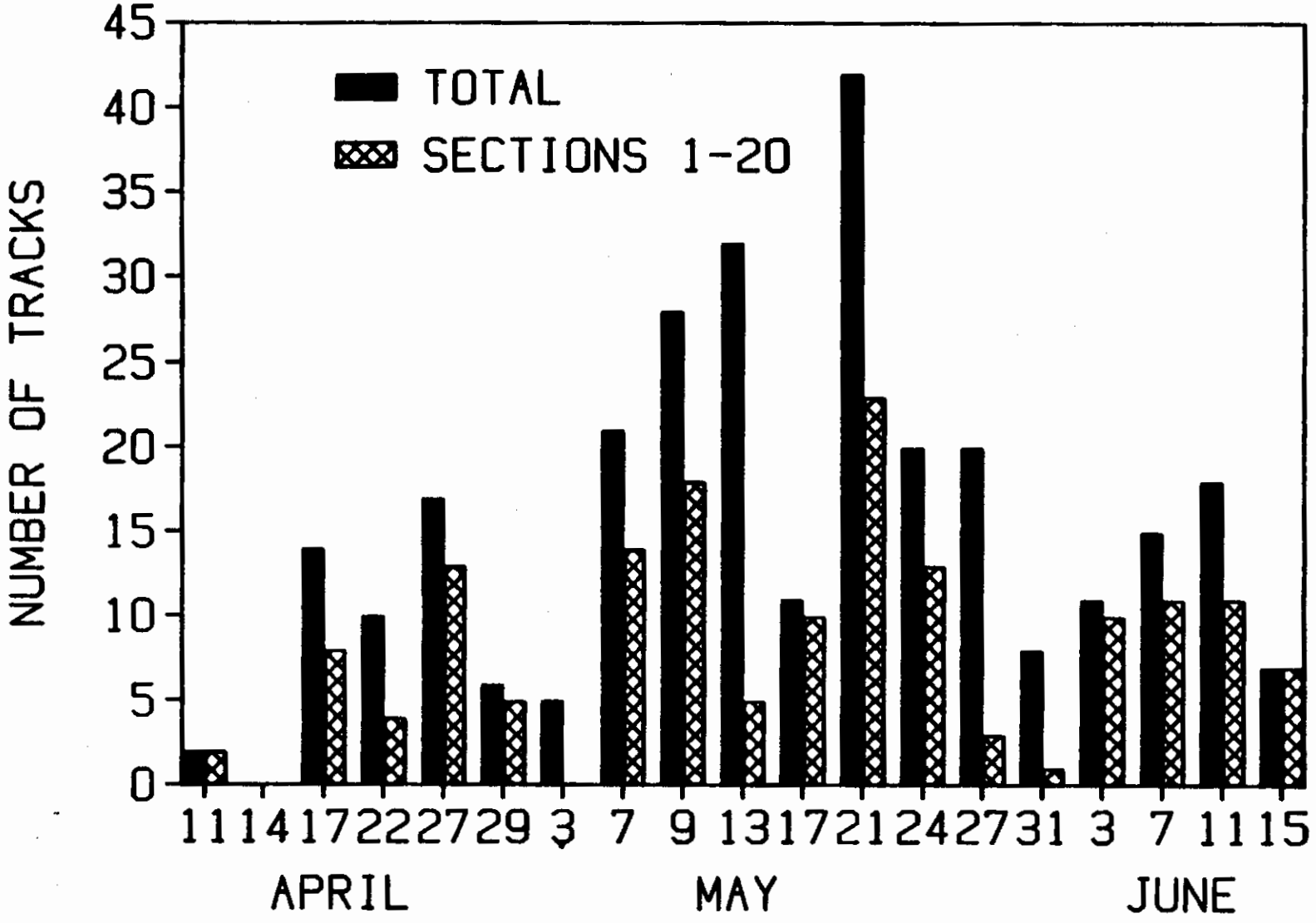
Beginning on 10 April 1988, the entire route was cleared of tracks and a tracking substrate prepared by dragging it with a "sled" pulled by a vehicle. This was done in late afternoon, and the following morning, the route was walked or driven and all deer tracks observed on the road were counted, both by survey section and by direction of travel. Data recorded were the number of individual deer making the observed tracks and their direction of travel. Because the route was dragged each evening before a survey to obliterate all tracks, the tracks counted on the surveys were made by animals within approximately the previous 12-18 hours. Recording tracks by survey section was designed to give a quantitative picture of the local pattern of deer movement in the Study Area. Recording tracks by direction of movement was designed to allow separation of back-and-forth or very localized movements from migrational movements.

RESULTS

1. Timing of deer activity

Figure 3 shows the total number of tracks made by individual deer throughout the period of study, presented without regard to direction of movement. To allow for comparison with last year's data, the totals for Sections 1 through 20 ara also shown; the difference between this and the total is the track count for the new sections. A pattern of a gradual increase in the number of tracks through May is apparent, with the greatest number of

FIGURE 3. TOTAL NUMBER OF DEER TRACKS IN THE PLES STUDY AREA, SPRING 1988



tracks, 42, counted on 21 May. The total numbers for Sections 1-20, most beween 5 and 20 tracks, are similar to the totals observed last year.

Figure 4 shows the breakdown of tracks counted on the surveys by direction of movement. Movements to the north and west are generally in the direction of the spring migration; those to the south and east west are opposite. Thus, subtracting the south and east-moving tracks from the north and west-moving ones, respectively, yields a crude estimate of the net number of deer moving through between the the dragging of the route and the survey. This is shown in Figure 5, in which the number of tracks heading south was subtracted from those heading north, and the number of tracks heading east was subtracted from those heading west, on each survey. Negative numbers may be interpreted as indicating predominantly localized, nondirectional movements. As indicated in Figure 5, most migrational movements in the Study Area occurred in late April and late May and early June.

2. Locations of deer movements

Figure 6 presents the total number of deer tracks by survey section counted during the spring of 1987. The large number of tracks indicated for Section 1 is somewhat misleading because that section is twice as long as the others. With this in mind, the distribution of tracks in survey sections 1 through 20 appears rather uniform. The totals, between 5 and 15, are also quite comparable to those of the 1987 spring survey. Track totals on the new sections, however, and especially Sections 21 and 22, are noticeably higher.

The net tracks by survey section are presented in Figure

FIGURE 4. DEER TRACKS BY DIRECTION OF MOVEMENT IN THE PLES GEOTHERMAL SITE, SPRING 1988

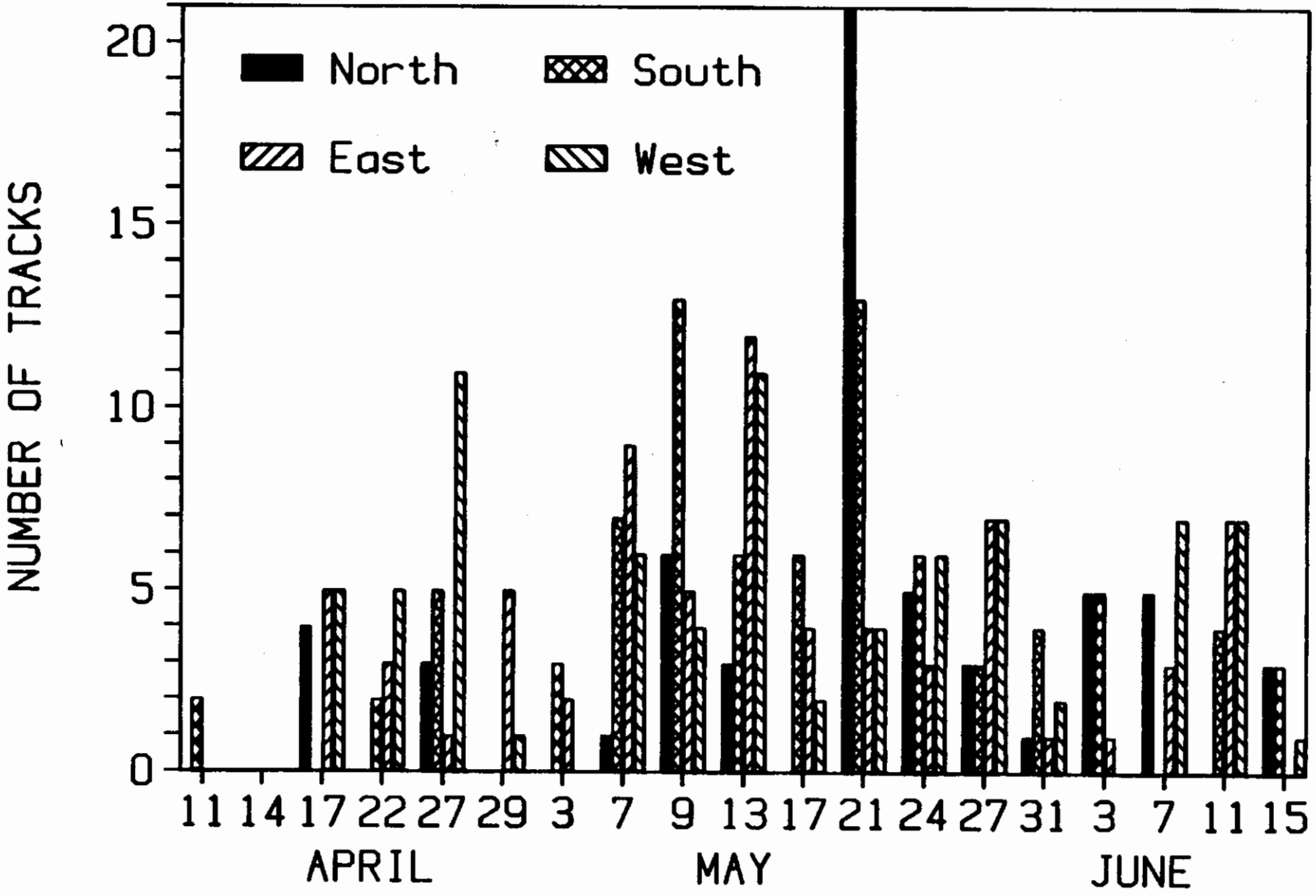


FIGURE 5. NET DEER TRACKS BY DIRECTION OF MOVEMENT IN THE PLES GEOTHERMAL SITE, SPRING 1988

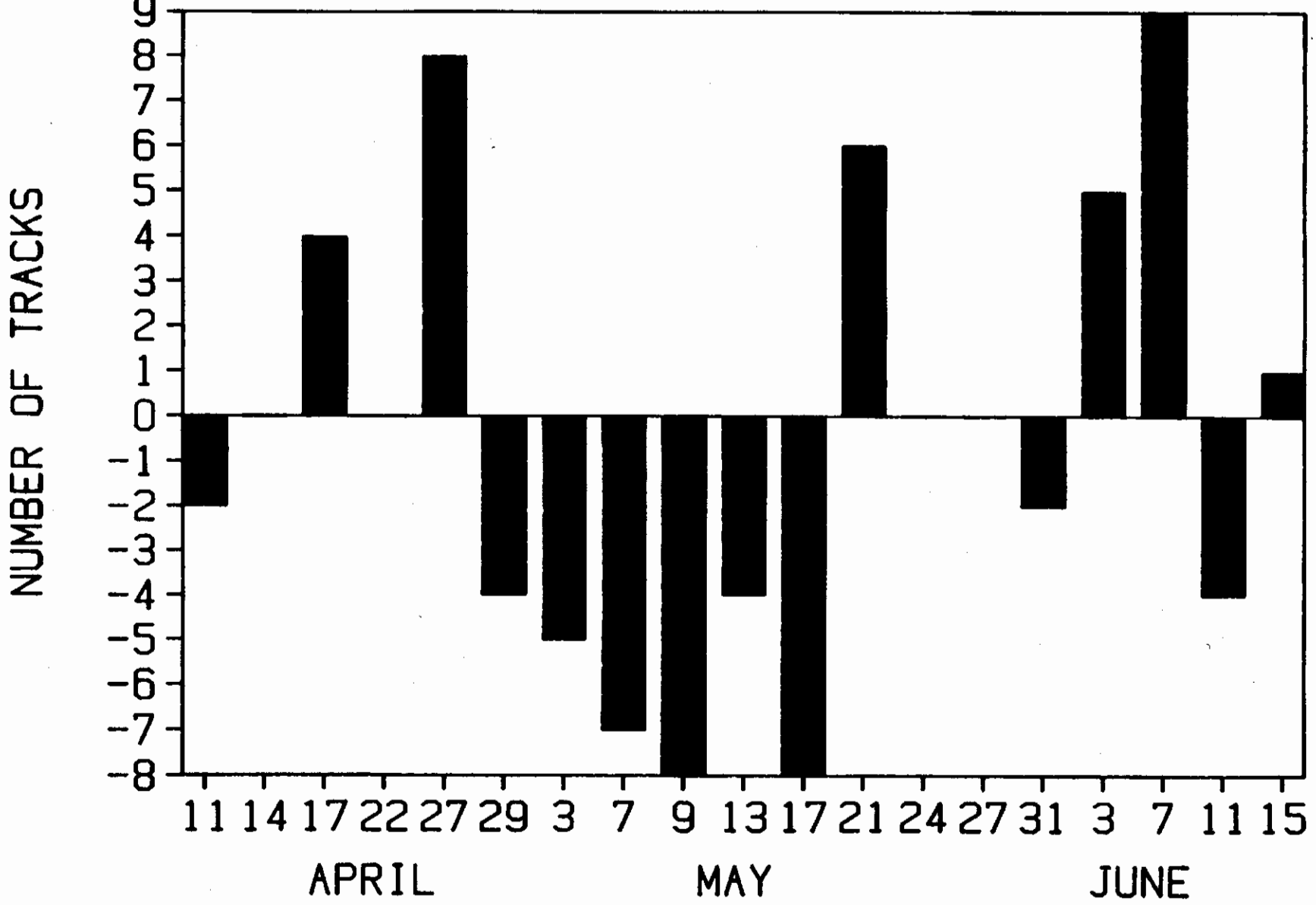
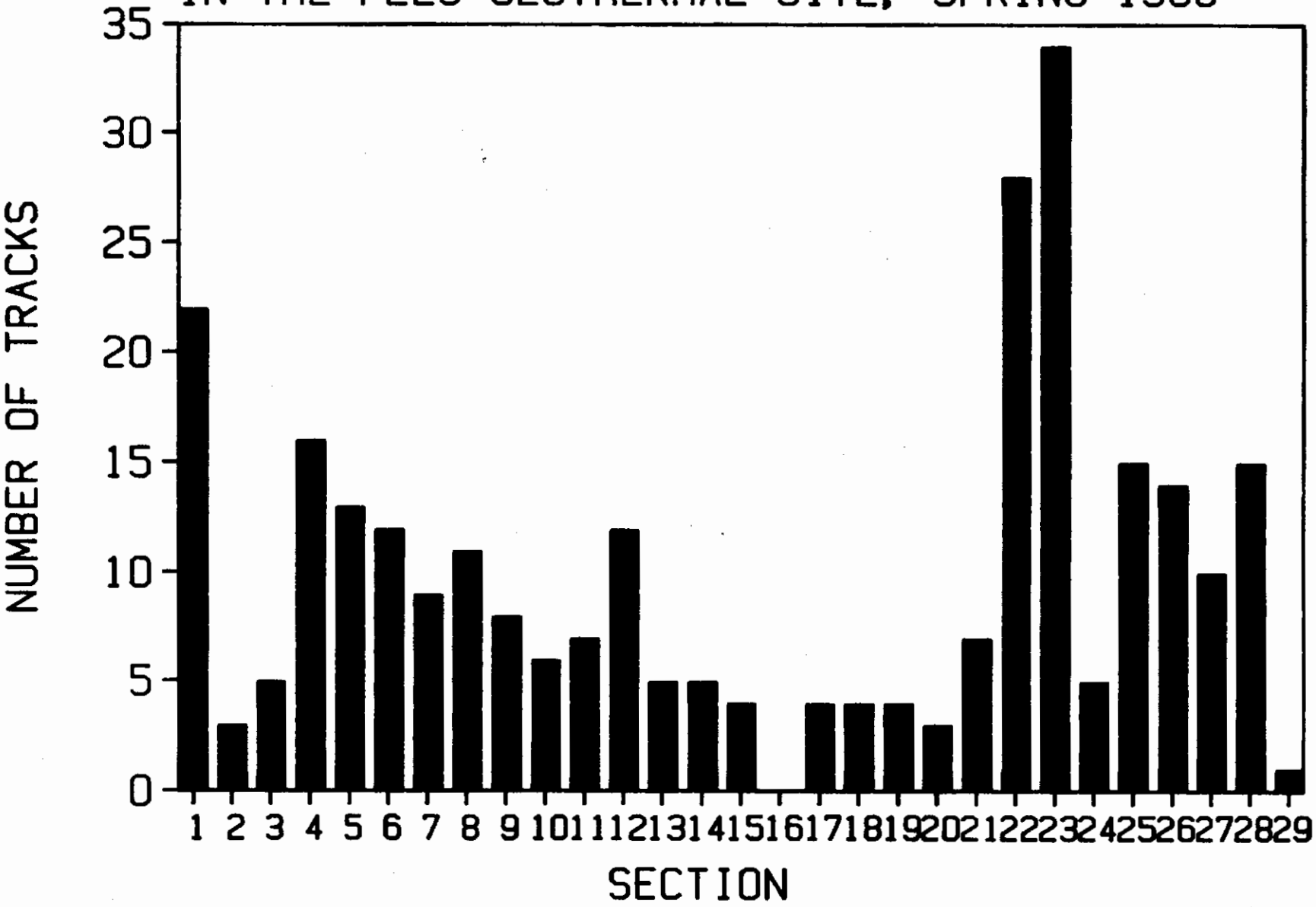


FIGURE 6. DEER TRACKS COUNTED BY SURVEY SECTION IN THE PLES GEOTHERMAL SITE, SPRING 1988



7. The first third of the route showed predominantly positive net track numbers, and on the rest of the route, the net was negative. It could be that animal movements in the eastern part of the Study Area, e.g., Sections 11 through 29, were larely a return to the cover provided by the slopes and vegetation in this area, perhaps after going to water or to feed at the base.

Throughout the survey period, only 7 deer were observed. On 9 May, a group of 4 adult females, 2 males and 1 fawn was seen near Section 20. No specific areas of deer movement or well-defined concentration areas were apparent from covering the area on foot.

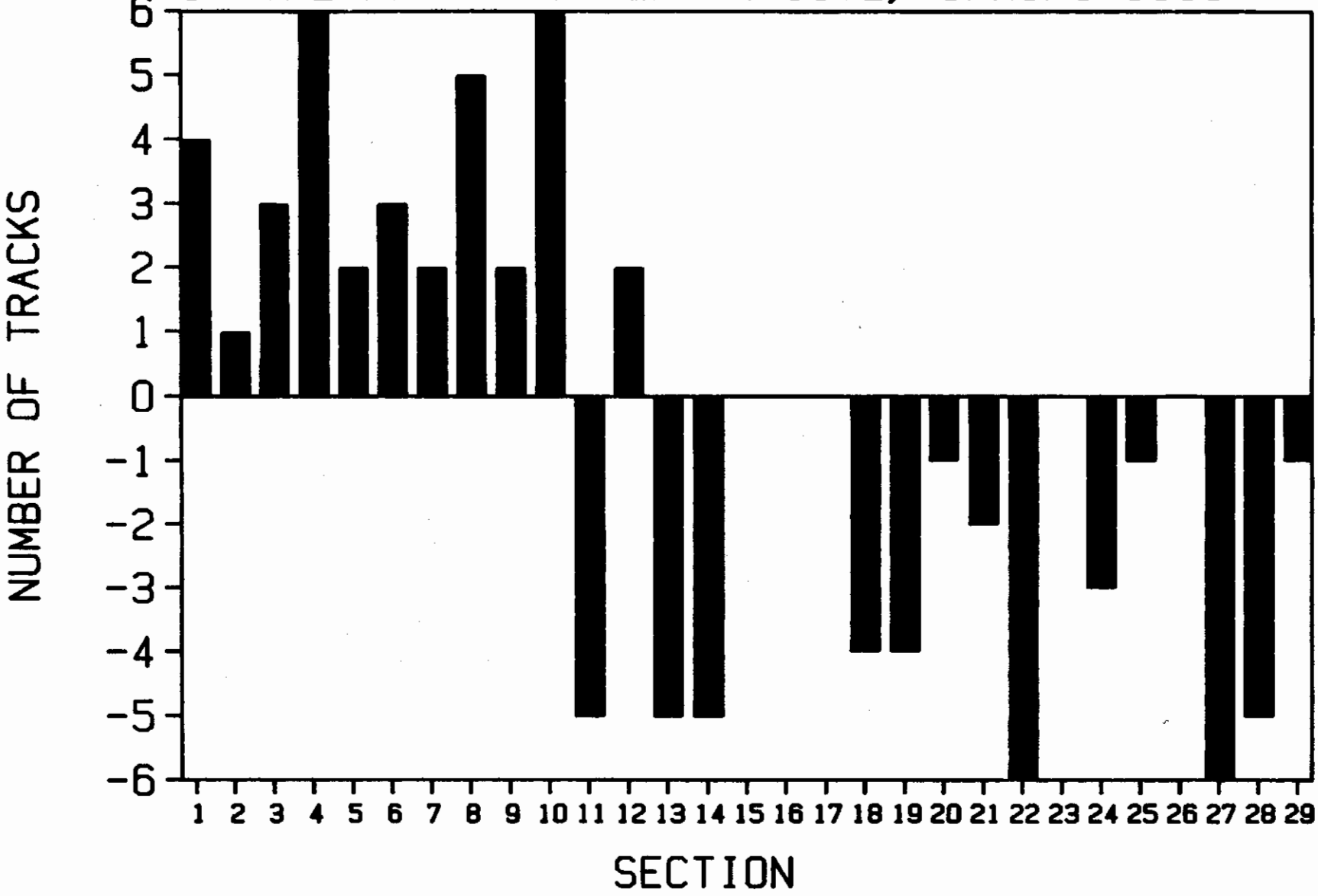
DISCUSSION

Results of the spring 1988 track surveys, quite similar to those of 1987, indicated a generally somewhat dispersed pattern of deer activity in and movement through the Study Area. No well-defined migration trails were observed, and the track counts showed deer activity in almost all sections. The new part of the survey route, Sections 21 through 29, showed heavier deer activity than the sections surveyed last year. This part of the route goes up a wooded, shrubby slope, and provides better habitat for deer, and less human disturbance, than areas at the base of the slope and near the road.

Deer movement through the area was apparent. Based on certain assumptions, I made a rough estimate of a total of 69 deer moving through the Study Area in spring of 1987. Given the overall level of activity seen in 1988, this seems like a reasonable estimate for the spring of 1988 as well.

This estimate of 69 deer is meant only as an approximation of the number of deer using the Study Area on spring migration.

FIGURE 7. NET DEER TRACKS BY SURVEY SECTION IN THE PLES GEOTHERMAL SITE, SPRING 1988



Potential sources of error, e.g., multiple counts of the same animal, or tracks missed because of poor tracking medium, are impossible to quantify. However, the precise number is not important; what matters is the estimate of magnitude. There certainly are not hundreds or thousands of animals using the area, as is the case in other local areas, but likely there are dozens. This movement does not appear to be concentrated in any localized portion of the Study Area, but is dispersed throughout it, which may not be surprising given its relatively small area and lack of extreme topography. It is likely that deer from three designated "herds" are involved: the Buttermilk, Sherwin Grade, and the Casa Diablo herds. Radioed or otherwise marked deer from all three herds have been observed in the vicinity of the Study Area. In previous years, the summer range of a radio-collared doe from the Sherwin Grade winter range partly included the area of Sections 21-29.

Recent radio-telemetry information indicates that, in general, most of the Buttermilk and Sherwin Grade deer which migrate north do so along the base of the mountains west of Highway 395. Likewise, most Casa Diablo deer move along the base of the Glass Mountains northwest of the Study Area. A portion of each herd, however, does move near or right through the Study Area. The specific areas used as migration corridors are probably dictated as such by both local topography and tradition.

Impacts of geothermal development on these migrating deer are difficult to predict precisely, but in a general sense are a function both of the location, amount and kinds of changes associated with the development, and of the availability of

alternate travel routes. It seems to be the case that deer activity is rather dispersed throughout the area. The locations of the proposed project facilities are shown in Figure 8. These occur most closely to Survey Sections 1, 2, and 15 through 18. Additional facilities likely will include a number of proposed wells, pipelines, and a transmission line, as well as the power plants. Section 1 had relatively high deer use, and Sections 15-18 relatively low (Figure 6). Assuming a "worst case" scenario, one in which deer completely avoid the proposed facilities and associated human disturbance, it is difficult to see how making several dozen deer move several hundred yards around the facilities would constitute a great hardship. Given the existing terrain, such an avoidance would likely have a trivial impact on migrating deer. Of course, certain facilities, e.g., fences, pipelines, etc., could be designed to minimize any impacts to deer and to facilitate their passage.

From the standpoint of deer migration, the locations of the presently proposed facilities (Figure 8) are less preferable than the site originally proposed (Kucera 1988). The present proposal would have the new power plants across Hot Springs Road from the existing plant, thus effectively increasing the area impacted by the project. In general, the more concentrated an area of disturbance, the less will be its deleterious impacts. The present configuration, however, apparently is preferable from the standpoint of minimizing visual impacts.

At present, alternate routes for spring migration exist, giving deer an opportunity to avoid the project area if

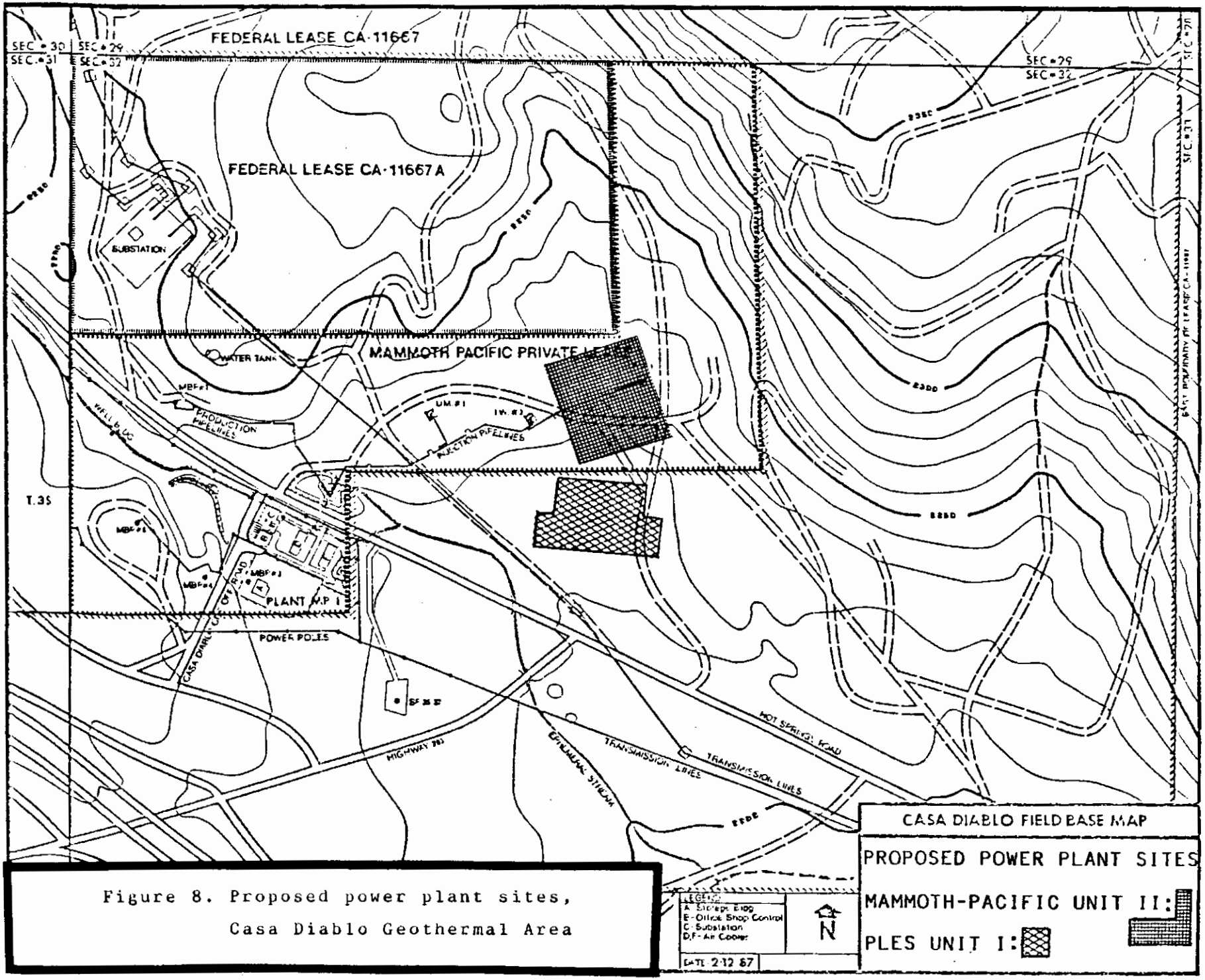


Figure 8. Proposed power plant sites, Casa Diablo Geothermal Area

developed. However, there are proposals for additional developments in the region, e.g., the Mammoth/Chance geothermal project, the Doe Ridge resort, the Sherwin Bowl Ski Area, the Snowcreek development, etc. Although it is impossible to discuss thoroughly the impacts of a project without reference to the context in which the project occurs, a regional summary and analysis taking such additional projects into account are not within the scope of the present work. No doubt the consequences of some of these proposed projects, because of their nature, size, and/or geographic location, are potentially much greater than those to be anticipated from Casa Diablo. Others may be more benign. The present study was not designed to evaluate cumulative impacts of projects outside of the Study Area.

The present investigation and discussion indicate that the Casa Diablo Geothermal Project, considered by itself, will likely not have a significant impact upon the spring migration. In the worst and unlikely case that deer avoid the project entirely, there are at present alternate routes available to allow migrating deer to reach their summer ranges. Thus, the Casa Diablo Geothermal Project by itself will likely have minimal negative impact.