Using NOREMARK to Estimate Populations of Tiger Beetles (Coleoptera: Cicindelidae) at Brookhaven National Laboratory

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Purpose
To identify species richness of tiger beetles at eight sites on Brookhaven National Laboratory (BNL) property and to estimate their populations using mark recapture methods.

Study Areas
Pitfall traps were buried at 4 sites (BB, NF, NB, TP) (Figure 1) while netting occurred at 4 sites (NF, FB, FBB, BL) (Figures 1-3). Tiger beetles exhibit one of two types of life cycle patterns: spring-fall or summer. For spring-fall species, hibernating adults emerge in the spring, mate, oviposit and die. The new brood emerges early fall, hibernates for the winter and emerges the following spring to repeat the cycle. The summer species emerge from the pupal stage in the early summer, mate, oviposit and die before the next winter. These species pass the winter in the larval stage [1,3,5].

So, why study tiger beetles? It has been found that the family Cicindelidae is an appropriate indicator taxon for determining regional patterns of biodiversity because it has a stabilized taxonomy, individuals are easily observed and manipulated, the life history and biology is well understood; occurrences are global with a broad range of habitats while each species has a specific habitat; patterns of species richness are highly correlated with those of other vertebrate and invertebrate taxa and the taxon include species of potential economic importance [6&7]. When making policy decisions of national conservation efforts, governments focus on species richness or biodiversity [6,8]. Since tiger beetles meet the logistical and biological criteria to be used as a bioindicator taxon, many conservation studies have utilized them as test organisms [9].

Materials and Methods
Eight sites were chosen for tiger beetle capture: New Burn A and B (NBA, NBB), North Fire Break (NF), Treatment Plant (TP), Balloon Launch (BL), Burying Beetle (BB), Fire Break (FB) and Fire Break B (FB B) (4). GPS coordinates were taken at each site while maps were created using GIS software Arc View 9.0 (Figures 1-3). Pitfall traps were fashioned by inverting the funneled top of a water bottle into the bottom (Figure 4) [18,9]. They were buried every 20 m apart at NBA, NBB, NF and TP (Figure 5). Netting was done in NF, BL, BB, FB and FBB (Figure 6). All captured beetles were measured (length and width), sexed, marked on the elytra with a xylene paint pen and released (Figures 7-9) [18]. Trap checks and netting occurred daily. New and recaptured beetles were documented. Population estimates were computed using the program NOREMARK [10].

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Results
Table 1 indicates species richness at 8 sites on BNL property. Five different species were found within the genus Cicindela. The total numbers captured for each site are given. Some individuals were recaptured either by netting or trapping. Table 2 shows the recaptured individuals and their captures on the marking site. Population estimates of 4 of the species were calculated using NOREMARK (Table 3). For statistical analysis, we used a null model

Discussion
There were two purposes for this study. First, tiger beetle species richness was to be identified at different habitat sites on BNL property. Second, once these individuals were captured a population study based on mark and release techniques was to be employed. The results in Table 1 indicate that indeed there is biodiversity of tiger beetles at BNL. Five species were identified: C. formosa generosa, C. punctulata punctulata, C. scutellaris rugifrons, C. sexguttata and C. tranquebarica tranquebarica and at least one of those species occurred at 7 sites. The most favorable habitats were BL, FB and FBB because they are open and have sandy substrate. One can see that out of the 78 individuals captured and released, 46 (58.9%) were C. punctulata punctulata. This species is a summer species while the other 4 are spring/fall species. Although we saw the other species, they were not prevalent.

Preliminary populations of tiger beetles were calculated using the program NOREMARK. The program could not estimate populations based on extremely small captures or no recaptures, therefore our estimates were limited to four species at their most prevalent sites (Table 3). One can see that C. punctulata punctulata has the largest population estimates at all 3 sites (BL=148, FB=31 and FBB=47) in a closed population and 178, 36, 70 respectively in an open population. Twelve out of the 78 marked individuals (15.3%) (Table 2) were recaptured at least once at their original location which leads us to believe tiger beetles tend not to immigrate or emigrate. BL numbers are larger because there were less recaptures whereas the most recaptures occurred at FB. C. sexguttata, C. tranquebarica tranquebarica and C. scutellaris rugifrons populations were estimated in the teens (in both open and closed models) which validate their spring/fall life cycle.

Conclusion
BNL has a diverse population of spring/fall and summer species of tiger beetles which may be used in conservation studies. These species are able to be captured, identified, marked, released and recaptured by way of pitfall traps or netting. Populations may be estimated from this mark and recapture technique.

References