Bull. Environ. Contam. Toxicol. (1984) 33:499–504


Bulletin of Environmental Contamination and Toxicology

# Nest Defense Behavior and Reproductive Success of Laughing Gulls Sublethally Dosed with Parathion

Kirke A. King, Donald H. White, and Christine A. Mitchell

U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Gulf Coast Field Station, P.O. Box 2506, Victoria, TX 77902

The organophosphorus (OP) insecticide parathion is used extensively in agriculture as a contact and stomach poison. Applications of OP compounds to crops often coincide with peaks of local avian abundance and have resulted in large-scale mortalities of nesting and migrating birds (Seabloom et al. 1973; Zinkl et al. 1977; White et al. 1979; Flickinger et al. 1980; White et al. 1982). Much less is known about the sublethal effects of OPs on avian populations. Laboratory studies have shown that sublethal levels of some OPs can affect physiological characteristics necessary for survival and reproduction (Rattner et al. 1982; Grue and Shipley; in press). Recent field and laboratory investigations suggest that behavioral patterns also may be altered by exposure to low levels of OP insecticides. Parental care was reduced in songbirds that received a sublethal dose of the insecticide dicrotophos (Grue et al. 1982) and mortality of nestling laughing gulls (*Larus atricilla*) may have resulted from lowered nest attentiveness by parents exposed to parathion (White et al. 1979). Results of a related field study (White et al. 1983) indicated that a single sublethal dose of parathion significantly altered the incubation behavior of laughing gulls. The purpose of the present study was to further assess the effects of a sublethal dose of a commonly used OP insecticide on nest-defense behavior and hatching success of laughing gulls.

## MATERIALS AND METHODS

Field work was conducted on Sundown Island in Matagorda Bay, Texas, from 12 May through 8 June 1983. About 10,000 pairs of laughing gulls nested on nearly 15 ha of the 20-ha island. Our activities were confined to nest sites situated along the periphery of the island, and whenever possible, we trapped birds at the vegetation line abutting the beach. We followed the nesting chronology of the gulls from the onset of the nesting season to assure that birds were captured during the early to mid-portion of the incubation period. On 18 May, gulls were captured on their nest between 0800 and 1400-h using conventional funnel traps (Weaver and Kadlec 1970).

Only one member of a pair was trapped at each nest. Bill length and body weight measurements were compared with laughing gull necropsy data to determine the sex of individual birds. Gulls then were orally intubated either with parathion in corn oil (treated group) or with corn oil only (controls) based on randomly pre-assigned treatment groups. During a pilot study, we determined that 5 mg/kg parathion inhibited brain acetylcholinesterase (AChE) activity an average of 46% after 18 h. No overt signs of poisoning were observed at that level of inhibition.

To facilitate observations of behavior, dosed gulls were color marked on the neck with rhodamine B dye before release. To eliminate the possibility of observer bias, gulls in both treated and control groups were identically marked. Eggs were individually numbered with a waterproof marking pen and nests were identified with numbered wooden stakes. After the gulls were treated and released, we moved all traps to a new area to minimize the effects of prolonged human disturbance.

Nests were revisited at 6, 24, and 30 h after dosing to assess the effects of the treatment on behavior. On these successive post-dose observations, all three investigators walked along the beach towards a staked nest. When a color marked bird was seen on the nest, two investigators stopped and assumed the role of observers while the third person proceeded directly towards the nest to determine flushing distance (in paces) and record nest contents. Most observations were made from the beach at least 75 m from the nest. We also recorded the following behavior variables: (1) immediate reaction including whether the bird remained in the area or flew out of sight, (2) estimated hovering distance of the marked gull above the investigator, and (3) elapsed time before the bird returned to the nest after the investigator walked away from the site. Return time observations were recorded in sec and terminated after 3 min if the gull had not returned to its nest. Upon completion of behavior observations, all nests were revisited 2 and 3 weeks later to determine hatching success. Mean flushing distance and return time of dosed gulls were compared with those of controls using a 2-sample t-test. A Chi-square test was used for comparison of hatching success of treated and control group eggs.

## RESULTS AND DISCUSSION

Twenty-four gulls (18 males, 4 females, 2 undetermined) were captured; 14 received parathion and 10 served as controls. All nests contained complete clutches of three eggs. We observed no evidence of direct mortality from trapping, handling, or parathion ingestion. During the first post-dose observation period 6 h after treatment, only two parathion treated birds and one control were observed at their nest (Table 1). Marked birds were observed at their nests more frequently during the 24 and 30 h observation period; overall, color-marked gulls were seen at 75% of the nests that remained active (n = 20) throughout the 30 h observation period. Flushing distance varied from 15 to 112 paces with no difference (P> 0.2) between parathion-treated and control birds. The time recorded for marked gulls to return to their nests varied from 15 sec to more than 3 min. We observed no difference (P> 0.05) in return time of treated vs. control birds. Estimates of distance that gulls circled above the investigator at the nest site were highly subjective, but we could distinguish no difference between test and control birds or between the color-marked birds and unmarked birds with nests in the same area.

TABLE 1. Flushing distance and return time of parathion treated laughing gulls vs. controls.

| Hours post-dose | Treatment | No. of observ.[1] | Mean (range) Flushing distance[2] | Mean (range) Return time[3] |
|---|---|---|---|---|
| 6 | control (n=10) | 1 | 65 | 120 |
| | treated (n=14) | 2 | 16,62 | 150,180 |
| 24 | control | 6 | 69 (47-99) | 90 (15-180) |
| | treated | 3 | 86 (80-92) | 120 (60-180) |
| 30 | control | 2 | 44,89 | 70,180 |
| | treated | 6 | 69 (15-112) | 128 (30-180) |

[1]Number of color-marked birds observed at nest sites per observation period.
[2]Distance from observer to nest in paces.
[3]Time in seconds for a color-marked bird to return to its nest.

One or more eggs hatched in 12 of 14 nests of the parathion-treated gulls and we found at least one hatched egg in 7 of 10 control nests (Table 2). Hatching success, as defined by the total number of eggs that hatched, was slightly but not significantly (P> 0.05, Chi-square) higher in the treated group (65%) than in the control group (50%). Because some chicks disappeared from their nests between the 2- and 3-week observation periods, data presented in Table 2 do not reflect true hatching success. Eggs disappeared from treated group nests only during the first 6 h after dosing but control group nests lost eggs throughout the 3-week observation period (Table 2).

TABLE 2. Reproductive success of laughing gulls receiving sublethal doses of parathion.

| | Post-dose observation period | | | | | |
|---|---|---|---|---|---|---|
| Treatment | 0 | 6h | 24h | 30h | 2wk | 3wk |
| Parathion | | | | | | |
| No. active nests | 14 | 12 | 12 | 12 | 12 | 12 |
| No. eggs | 42 | 36 | 36 | 36 | 14 | 2 |
| No. young | - | - | - | - | 18 | 22 |
| Control | | | | | | |
| No. active nests | 10 | 8 | 8 | 8 | 7 | 6 |
| No. eggs | 30 | 22 | 21 | 18 | 14 | 3 |
| No. young | - | - | - | - | 3 | 9 |

The proportion of males to females captured at their nest was significantly ($P < 0.05$, Chi-square) greater than the 48:52 ratio for incubating gulls reported by Burger and Beer (1976). We have no explanation as to why we captured such a disproportionately large number of males, except that male gulls may be more aggressive than females at entering the traps. Because incubation duties are shared by both male and female gulls (Burger and Beer 1976), we expected that the marked member of a pair would be observed at the nest site about one-half of the time in successive observation periods after dosing. The actual proportion of marked to unmarked gulls at nest sites was much lower than anticipated and varied from 13 to 38%. Our observations of flushing distance and return time therefore, were somewhat limited. We also encountered several unforeseen obstacles in determining flushing distances. In some cases, dense vegetation formed a visual barrier between the incubating gull and the approaching observer allowing the investigator to walk relatively close to the bird before it flushed. On the other extreme, gulls in certain sections of the colony seemed especially wary and on some occasions groups of birds near the marked nest would flush while the approaching observer was 100-150 m distant; their alarmed behavior appeared to cause the marked gulls to take flight prematurely. We observed no difference in flushing distance of parathion-treated vs. control gulls but our assessments of this behavior parameter may have been influenced by the stated environmental factors.

On numerous occasions during recent years, one of the authors (KAK) has witnessed disturbance of incubating laughing gulls by predators such as dogs (*Canis familiaris*), opossums (*Didelphis* *virginiana*), and rattlesnakes (*Crotalus atrox*). When disturbed by these natural predators, nest defense behavior consisted of gulls hovering over and diving at the predator. In this field test, birds in both parathion-treated and control groups circled over the investigator while the person was at or near the nest. The gulls did not appear to dive at the human predator.

About 84% of the marked birds that flushed from their nests returned and landed at or near the site within 3 min after the departure of the investigator. With one exception, all birds that did not return within the 3 min observation period circled in the vicinity of the site. Only one color-marked gull flew from the area on approach of the investigator. However, on closer inspection of the nest and of our records, we realized that the nest had been destroyed earlier.

The rate of nest desertion during this study appeared to be excessive. Four of 24 nests were abandoned during the first 6 h of the test, a desertion rate of 17%. A total of 6 nests were deserted before the termination of the project 3 weeks after dosing. In an earlier study in which gulls were similarly trapped and handled, the nest desertion rate (3%) was much lower, (King and Lefever 1979). In this study, all gull nests were marked with readily identifiable stakes and nests were located in easily accessible sites adjacent to beach areas frequented by fisherman. To our knowledge, the nests were not subjected to extensive disturbances by noninvestigators, but disturbance was possible because numerous fishermen were seen on the island during this study.

In addition to an unusually high desertion rate, hatching success in nests that remained active also was below the expected level. Hatching success of three-egg laughing gull clutches in Florida colonies ranged from 78 to 87% in 1975-76 (Schreiber et al. 1979) and success in comparable Galveston Bay, Texas, colonies varied from 73 to 81% (King unpublished data). Hatching success in this study varied from 50 to 64% with no difference in success between parathion treated and control birds.

While a single sublethal dose of parathion had no effect on nest defense behavior or hatching success, repeated ingestion of contaminated food items is possible and the effects of multiple sublethal doses remains to be determined. Also, our study focused on the effects of sublethal exposure of only one member of a pair. Under natural conditions, both members are likely to be exposed to an organophosphate insecticide.

Acknowledgments. We thank Barnett Rattner and Ken Stromberg for manuscript review. Appreciation also is expressed to the National Audubon Society for their support in this study.

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Received March 20, 1984; accepted April 6, 1984