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Effects of No. 2 Fuel Oil on Hatchability of Marine and Estuarine Bird Eggs

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Oil spills and discharges may kill birds directly by destroying the insulation that their feathers provide so that they die of exposure; by poisoning them if they ingest oil; and by stressing them so that they starve to death. But oil pollution has more subtle effects, too. Nesting birds exposed to sublethal quantities of oil may transfer the oil to eggs in their nests, thereby causing failure of the eggs to hatch (RITTINGHAUS 1956). Laboratory studies have shown that very small quantities of oil, when applied to eggs of waterfowl, significantly reduced hatchability (HARTUNG 1965, ALBERS 1977a, SZARO and ALBERS 1977). The objective of this study was to determine the effects of external applications of No. 2 fuel oil on embryo survival of naturally and of artificially incubated eggs of marine and estuarine birds.

MATERIALS AND METHODS

The field portion of our study was conducted on Sundown Island, in Matagorda Bay, Texas, one of the largest breeding colonies on the Texas coast. We selected three abundant species, the Louisiana heron *(Hydranassa tricolor)*, the laughing gull *(Larus atricilla)*, and the sandwich tern *(Sterna sandvicensis)*, in the spring of 1977 for our egg-oiling experiments.

All three species nested in closely packed colonies. The Louisiana herons built nests of sticks in shrubs of saltbush *(Baccharis* sp.), usually about 1 or 1.5 m from the ground. Sandwich terns and laughing gulls nested on the ground; tern nests were bare scraped-out depressions in the sand, whereas, the gull nests consisted of sticks and grass. Clutch size of the Louisiana heron and laughing gull averaged about three eggs; sandwich tern clutches contained only one egg. Nesting activity of the selected species was closely monitored to assure that eggs had been incubated less than one week before oiling (ALBERS 1977b). Eggs of Louisiana herons and sandwich terns were oiled on 20 April; laughing gull eggs were oiled on 12 May 1977.

Each oil-treatment group and control group consisted of 60 eggs. Nests of each species were randomly selected and their locations were marked with numbered stakes. The eggs of even-numbered nests served as controls and those in odd-numbered nests received applications of oil. All eggs within a clutch

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were marked with the assigned clutch number using a black felt-tipped pen. Each egg in the oil-treatment group received 20 µl of No. 2 fuel oil; the oil was dispensed from a microliter syringe in four 5 µl fractions to the air cell end of the egg and allowed to run freely (ALBERS 1977b). After the eggs were naturally incubated by the adults for 5 days, all eggs were collected and opened immediately to ascertain embryo mortality.

The laboratory portion of our study was conducted at the Patuxent Wildlife Research Center, Laurel, Maryland. Eggs of Louisiana herons, laughing gulls, and sandwich terns were collected from Sundown Island and transported to Patuxent within 24 hr; the eggs were collected concurrently with the field egg-oiling experiments on 20 April and 12 May 1977.

Immediately upon arrival at Patuxent, the eggs were transferred to an incubator for a few hours before being treated. A portion of the Louisiana heron and sandwich tern eggs received 20 µl of No. 2 fuel oil. Two groups of laughing gull eggs were oiled, one with 20 µl of No. 2 fuel oil and one with 5 µl. The eggs were returned to the incubator and maintained at 37.5°C and 55% relative humidity for 30 days, or until hatching. Embryonic survival and hatching success were ascertained.

RESULTS AND DISCUSSION

Applications of No. 2 fuel oil caused significant embryonic mortality in naturally incubated eggs within 5 days (Table 1). Mortality in laughing gull eggs was significantly greater ($P<0.005$) than in eggs of the other two species; however, there was no difference ($P>0.05$) in mortality rates between Louisiana herons and sandwich terns. The fertility rate of the three species was very high; only 5 of 338 eggs (1%) that were recovered were infertile. Only 2% (8 of 338) of the eggs examined in the field had advanced embryos (> one week old); therefore, age of the embryos at time of treatment was not a biasing factor in the statistical analyses.

Hatching success of the oil-treated eggs in the incubator study was very low; but hatching success in the control groups was also less than expected (Table 2). Although differences were indicated between control and treated groups, we felt that statistical analysis of the data would be biased because factors other than oil applications apparently affected hatchability. Examination of the control eggs of Louisiana herons and sandwich terns that failed to hatch revealed that most of the dead embryos were between 1 and 8 days old. So mortality must have occurred soon after the eggs were collected, perhaps during shipment to the laboratory. On the other hand, most of the dead embryos in control eggs of laughing gulls were between 17 and 25 days old; this indicated another problem perhaps within the incubator prior to hatching. Nevertheless, No. 2 fuel oil appears to have significantly reduced the hatchability of artificially incubated eggs.

TABLE 1

Embryonic mortality in eggs during 5 days of natural incubation after external applications of No. 2 fuel oil.

Species	Treatment	N[a]	No. Dead (%)	No. Alive (%)	No. Infertile (%)
Louisiana Heron	Control	57	0(0)	54(95)	3(5)
	20 μl	59	36(61)[b]	22(37)	1(2)
Sandwich Tern	Control	54	0(0)	54(100)	0(0)
	20 μl	54	30(56)[b]	23(43)	1(2)
Laughing Gull	Control	56	1(2)	55(98)	0(0)
	20 μl	58	48(83)[bc]	10(17)	0(0)

[a] N = Number of eggs recovered after 5 days; initial sample size in each group was 60.

[b] Significantly different from controls, $P<0.005$, Chi-square test.

[c] Significantly different from sandwich terns and Louisiana herons, $P<0.005$, Chi-square test.

TABLE 2

Hatching success of artificially incubated eggs after applications of No. 2 fuel oil.

Species	Treatment	N	No. Pipped (%)	No. Hatched (%)
Louisiana Heron	Control	54	10(19)	9(17)
	20 μl	48	1(2)	1(2)
Sandwich Tern	Control	44	28(63)	27(61)
	20 μl	44	0(0)	0(0)
Laughing Gull	Control	51	44(86)	26(51)
	5 μl	51	12(24)	12(24)
	20 μl	51	2(4)	2(4)

Energy demands of the nation require increased exploration, removal, processing, and transport of petroleum hydrocarbons. These operations are taking place along the Texas coast at a very fast pace, probably more so than in any other state. The ports of Galveston, Port Arthur, and Corpus Christi are major importers and exporters of petroleum products; in addition, plans to build a deep-water superport at Freeport now are being developed.

At present, vast numbers of marine and estuarine birds use the Texas coast and off-shore islands as breeding sites; also, millions of waterfowl and shorebirds spend the winter in this area. It is recognized that increased environmental contamination from petroleum operations is unavoidable, and that wildlife populations may be adversely affected, either directly or indirectly. It is highly possible that oiled birds could contaminate their nest contents. In our study minute quantities of oil caused significant embryo mortality and reduced hatchability in aquatic bird eggs; therefore, we conclude that oil pollution could seriously affect breeding marine and estuarine birds.

SUMMARY

Eggs of Louisiana herons, sandwich terns, and laughing gulls were oiled with either 0, 5, or 20 μl of No. 2 fuel oil in the field and in the laboratory. After 5 days of natural incubation, field-oiled and control eggs were opened and embryonic mortality was determined. No. 2 fuel oil produced 61% mortality in Louisiana heron eggs, 56% in sandwich tern eggs, and 83% in laughing gull eggs.

Hatching success of artificially incubated, oiled eggs appeared to be lower than in control eggs. However, stress during shipment to the laboratory and problems within the incubator probably contributed to reduced hatchability in both groups.

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