REHABILITATION OF BIRDS OILED ON TWO MID-ATLANTIC ESTUARIES

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Abstract: An estimated 52,500 birds died as a result of 7 major oil spills on 2 mid-Atlantic estuaries between 1973-78. Ruddy ducks (*Oxyura jamaicensis*) constituted 98% of 12,500 birds known to have died from 5 spills on the Delaware River. Seventy-six percent of 40,000 dead birds from 2 Chesapeake Bay spills were horned grebes (*Podiceps auritus*) and oldsquaw (*Clangula hyemalis*). Oiled waterfowl that were captured alive (6% of the estimated mortality) were cleaned with a variety of cleaning agents and techniques. High mortality occurred during and shortly after cleaning, and was apparently due to hypothermia and to toxicity of solvent cleaning agents. Eighty-two percent of the 3,113 birds that were cleaned died prior to or at time of release. The fate of the remaining 18% is unknown. Petroleum solvents used as cleaning agents were toxic to the birds. Most detergents left a surfactant (wetting agent) on the feathers which resulted in subsequent wetting of released birds. Although rehabilitation techniques have improved in recent years, high bird mortality can be expected following future oil spills.

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Human misuse of oil during the last century has caused the death of unknown numbers of birds that have perished after encountering oil in the aquatic environment. Most large oil spill incidents have resulted from accidents of transport vessels which accounted for 66% of the volume of oil spilled in 1977 (USCG 1978). Sources of smaller spills on water include offshore oil production, oil transfer at dock facilities and purging of ships' bilges at sea. There does not appear to be a positive correlation between the size of spills and the number of birds oiled. The location of the spill and the time of the year are critical factors causing high bird mortality.

Most oiled bird problems occur during the winter when the birds are concentrated in coastal areas. Two major mortality factors associated with birds exposed to oil are (1) hypothermia–birds lose insulation due to oiled feathers and suffer rapid heat loss, and (2) starvation–birds stop feeding and spend time on land attempting to preen the oil from the feathers. These major mortality factors often act together or are augmented by additional factors.

The pathetic appearance of a duck helplessly covered with oil has stimulated private individuals and government conservation agencies to attempt salvage of the birds. Although numerous techniques and cleaning agents have been developed, most attempts to clean and rehabilitate large numbers of oiled birds have failed. In practically all documented cleaning operations, mortality was over 75% and in many cases was close to 100% (Orr 1971, Clark & Kennedy 1968). Some improvements, however, have been made in recent years (Williams 1977). It is the policy of the U.S. Fish and Wildlife Service to assist in the collection of oiled birds and to either rehabilitate them or support other efforts to rehabilitate them (Nelson 1977).

The objectives of this paper are (1) to summarize effects of 7 major mid-Atlantic oil spills on bird mortality and rehabilitation, and (2) to discuss rehabilitation techniques that could minimize bird mortality in future oil spills.

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METHODS

Rehabilitation efforts for oiled birds from 7 mid-Atlantic oil spills (Fig. 1) began when volunteers and professional wildlife personnel caught birds that were incapacitated by oil on their feathers. Birds were caught during the day and night by people walking the shoreline or from boats for approximately 3 weeks after each spill. Oiled birds were taken to collection areas and then transferred to rehabilitation centers (garages, warehouses, etc. that were set up to clean birds). Rehabilitation was supervised by state and / or federal wildlife biologists.

Rehabilitation techniques for oiled birds were based on those described by Clark (1972), Naviaux (1972), Stanton (1972) and Williams (1978). In these techniques birds are cleaned individually in small wash tubs with various cleaning agents. One additional technique was a "self-cleaning" process that was used on a group of birds (mostly ruddy ducks) from the February 1974 oil spill. In that test, groups of from 10-20 oiled birds were placed in tanks (2.4 m x .8 m x .8 m) that had 5-10 cm of warm water and detergent in the bottom and allowed to clean themselves for 10-15 minutes per group.

There were 11 major cleaning agents, including both detergents and petroleum solvents, used to clean oiled birds (Table 1). They were used on birds that were oiled with light and heavy crude oil. Weights were taken on some birds before cleaning and when released as an indication of their physical condition. Some birds were banded to determine survival rate. Rehabilitated birds were released in areas that did not have oil contamination.

RESULTS

Delaware River Oil Spills

Between December 1973 and December 1976, 5 major oil spills occurred on the lower Delaware River (Fig. 1). A major discharge is defined by the USCG as more than 100,000 gallons or a discharge of a hazardous substance that poses a substantial threat to the public health or welfare or "results in critical public concern". Approximately 1 million gallons of oil spilled on the River, resulting in large waterfowl mortalities (Table 2).

Nearly all (98%) of the birds impacted by the oil spills on the Delaware River were ruddy ducks. Small numbers of 16 other species of birds were oiled (Table 3). Large numbers of ruddy ducks concentrate in the tidal portion of that river apparently because of the abundance of oligochaetes in the sediment (Stark and Lindzey 1978). During the winters of 1973-76, 8000 to 10,000 ruddy ducks were observed between Philadelphia and the Delaware River Bridge (Ferrigno & Widjeskog 1974).

Oiled birds were most successfully captured when low tide stranded them on beaches. Those ducks with the least oil on them and which had the greatest chance of survival after cleaning, avoided capture. Some of these birds were caught at a later date when they had become weakened due to emaciation. However, a correlation does not appear to exist between the amount of oil on birds and their ability to survive.

Solvents were found to be very toxic and caused high mortality of birds during and immediately following cleaning. This was in contrast to reports by Naviaux (1972) and Myers (1973) who reportedly used solvents in the successful cleaning of oiled birds. Over 90% of all birds cleaned with solvents were dead within 12 hours. Death apparently resulted from inhaling vapors of the solvents or from contact of the solvent with their skin.

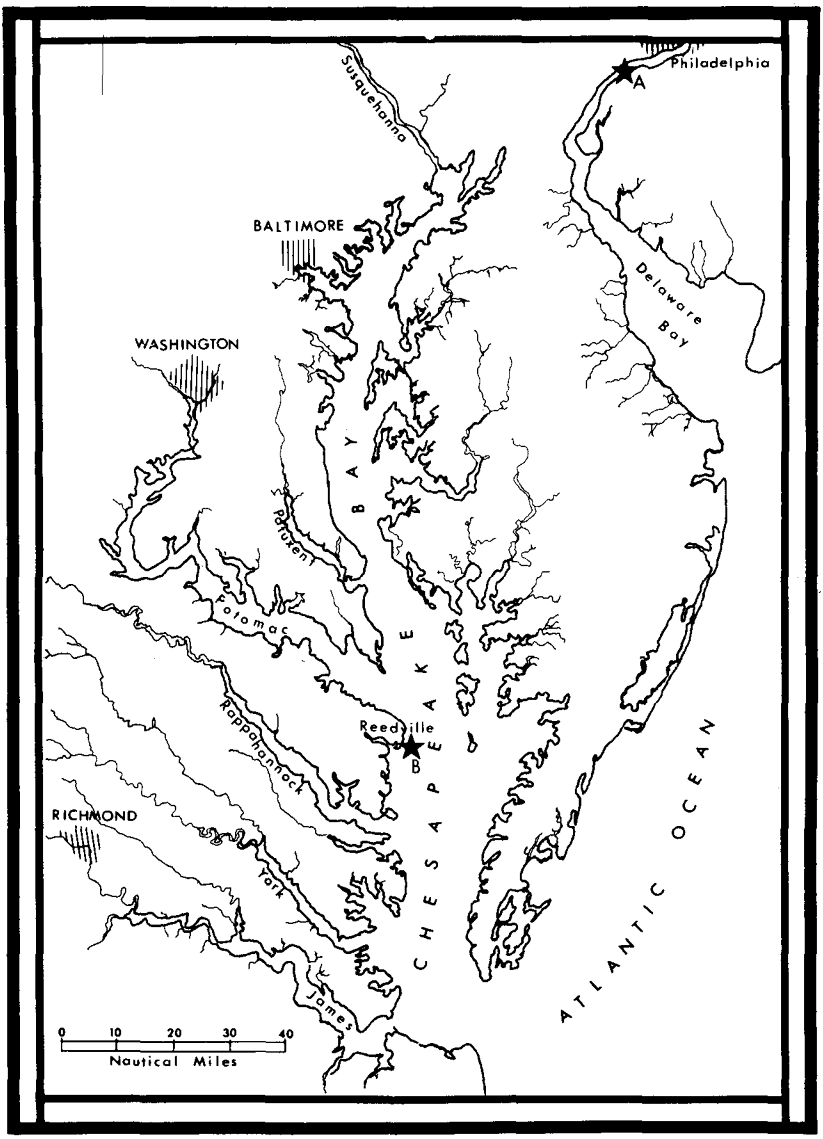

Fig. 1. Locations of oil spills on the Delaware River (A) and Chesapeake Bay (B) 1973-78.

Table 1. Results of cleaning of oiled birds from seven oil spills.

Date of spill	Oil type	Major Cleaning agents used[a]	Birds Cleaned No.	Known mortality	Fate unknown
Delaware River					
26 Dec 73	Light Crude	Gulfsol 10 ! 20 Basic H	852	503 (59%)	349 (41%)
19 Feb 74	Bunker "C"	Polycomplex A-11 Basic H Liquid Concentrate	438	417 (95%)	21 (5%)
9 Apr 74	Heavy Crude	·Gulfsol 20 Basic H	60	45 (75%)	15 (25%)
31 Jan 75	Light Crude	Basic H Shellsol 71 Foresight	384	376 (98%)	8 (2%)
27 Dec 76	Light Crude	Amway L.O.C. Polycomplex A-11 Pink Lux	375	369 (98%)	6 (2%)
			2,109	1,710 (81%)	399 (19%)
Chesapeake Bay					
1 Feb 76	Bunker "C"	Amway L.O.C. Shellsol 71	581	549 (94%)	32 (6%)
27 Feb 78	Bunker "C"	Amber Lux	423	309 (73%)	114 (27%)
			1,004	858 (85%)	146 (15%)
		Totals	3,113	2,568 (82%)	545 (18%)

[a]Use of trade names does not imply government endorsement of commercial products.

Table 2. Summary of major oil spills affecting birds in two mid-Atlantic estuaries 1973-1978.

Date	*Location*	*Cause*	*Gallons*	*Oil type*	*Estimated mortality*[a]	*Species affected*
Delaware River						
26 Dec 1973	Chester, PA	Grounding Tanker "Mellon"	126,000 Crude	Light Nigerian	4,000	Ruddy Duck (99%)
19 Feb 1974	Paulsboro, NJ	Collision 2 Tankers	500,000	Bunker "C"	3,500	Ruddy Duck (98%)
9 Apr 1974	Ft. Miflin, PA	Explosion Tanker "Elias"	10,000	Heavy Venezuelian Crude	500	Ruddy Duck (98%)
31 Jan 1975	Marcus Hook, PA	Collision Tankers "Queeny" & "Corinthos"	312,000	Light Nigerian Crude	2,500	Ruddy Duck (99%)
27 Dec 1976	Philadelphia, PA	Grounding Tanker "Olympic Games"	133,000	Light Arabian Crude	2,000	Ruddy Duck (86%)
					12,500	
Chesapeake Bay						
1 Feb 1976	Smith Point, VA	Sinking Barge "STC 101"	250,000	Bunker "C"	30,000	Horned Grebe (46%) Oldsquaw (40%)
27 Feb 1978	Smith Point, VA	Grounding Barge "ATC 133"	25,000	Bunker "C"	10,000	Oldsquaw (38%) Goldeneye (16%)
					40,000	

[a]Conservative estimates based on actual counts of 14,108 dead birds.

Table 3. Avian mortality from 7 mid-Atlantic oil spills, 1973-78[a].

	Delaware River 1973-76 N (%)	*Chesapeake Bay* 1976 N (%)	*Chesapeake Bay* 1978 N (%)	*Total* 1973-78 N (%)
Oldsquaw (*Clangula hyemalis*)	6 (tr)	11900 (39.6)	3809 (38.1)	15715 (29.9)
Horned grebe (*Podiceps auritus*)	11 (0.1)	13700 (45.7)	860 (8.6)	14571 (27.8)
Ruddy duck (*Oxyura jamaicensis*)	12225 (97.8)	350 (1.2)	90 (0.9)	12665 (24.1)
Surf scoter (*Melanitta perspicillata*)		1690 (5.6)	400 (4.0)	2090 (4.0)
Com. goldeneye (*Bucephala clangula*)		330 (1.1)	1650 (16.5)	1980 (3.8)
Scaup (*Aythya* spp.)	100 (0.8)	70 (0.2)	1340 (13.4)	1510 (2.9)
Canvasback (*Aythya valisineria*)	15 (0.1)	30 (0.1)	770 (7.7)	815 (1.6)
Bufflehead (*Bucephala albeola*)		530 (1.8)	260 (2.6)	790 (1.5)
Com. loon (*Gavia immer*)		650 (2.2)	30 (0.3)	680 (1.3)
Wh. swan (*Cygnus columbianus*)	5 (tr)	185 (0.6)	170 (1.7)	360 (0.7)
Com. scoter (*Melanitta nigra*)	1 (tr)	65 (0.2)	270 (2.7)	336 (0.6)
Herring gull (*Larus argentatus*)	15 (0.1)	130 (0.4)	170 (1.7)	315 (0.6)
Can. goose (*Branta canadensis*)	85 (0.7)	30 (0.1)	90 (0.9)	208 (0.4)
Redhead (*Aythya americana*)		120 (0.4)		120 (0.2)
D.-cr. cormorant (*Phalacrocorax auritus*)		60 (0.2)		60 (0.1)
Mallard (*Anas platyrhynchos*)	12 (0.1)	5 (tr)	30 (0.3)	47 (0.1)
Black duck (*Anas rupribes*)	14 (0.1)	30 (0.1)		44 (0.1)
Com. merganser (*Mergus merganser*)	3 (tr)	39 (0.1)		42 (0.1)
Red-br. merganser (*Mergus serrator*)		6 (tr)	30 (0.3)	36 (0.1)
Wh.-wing scoter (*Melanitta deglandi*)		30 (0.1)		30 (0.1)
Gr. bl. backed gull (*Larus marinus*)			30 (0.3)	30 (0.1)
Ring-billed gull (*Larus delawarensis*)		10 (tr)		10 (tr)
Blue-winged teal (*Anas discors*)		8 (tr)		8 (tr)
Gr.-blue heron (*Ardea herodias*)		7 (tr)		7 (tr)
Am. wigeon (*Anas americana*)		5 (tr)		5 (tr)
Brant (*Branta bernicla*)		4 (tr)		4 (tr)
Gr.-winged teal (*Anas crecca*)		4 (tr)		4 (tr)
Clapper rails (*Rallus longirostris*)		3 (tr)		3 (tr)
Red-w.-blackbird (*Agelaius phoeniceus*)		3 (tr)		3 (tr)
Am. coot (*Fulica americana*)		3 (tr)		3 (tr)
Pintail (*Anas acuta*)		2 (tr)		2 (tr)
Domestic duck (*Anas* sp.)	1 (tr)			1 (tr)
Ring-nk. duck (*Aythya collaris*)	1 (tr)			1 (tr)
Oystercatcher (*Haematopus palliatus*)		1 (tr)		1 (tr)
Mourning dove (*Zenaidura macroura*)	1 (tr)			1 (tr)
Rock dove (*Columba livin*)	1 (tr)			1 (tr)
Am. kestrel (*Falco sparverius*)	1 (tr)			1 (tr)
Water pipit (*Anthus spinoletta*)			1 (tr)	1 (tr)
	12,500	30,000	10,000	52,500

[a] Numbers are estimates based on actual counts of 14,108 dead birds. Sources of data besides the authors include L. Widjeskog, M. Wass, G. Hodge and A. Willet.

Mortality during the first 12 hours following cleaning with detergents was 45%. Although loss of birds cleaned with detergents was initially less than those cleaned with solvents, actual losses were probably nearly equal. Large numbers of birds died from hypothermia when they were released because of the wetting of their feathers and the resultant loss of insulation and buoyancy. This problem apparently occurred because the surfactants (wetting agents) in the detergents were difficult to remove from the feathers. Some birds remained in captivity for 4 months before they were released.

Eighty-one percent of the 2109 ruddy ducks from 5 Delaware River spills died before or during release to the wild. The fate of the remaining 19% that were released is unknown except for 2 with bands that were shot by hunters 1.5 years after release. Mortality of most of the released birds was probably high based on the wet appearance of the birds on the water following release.

The "self-cleaning" process used in the 1974 Delaware River oil spill was much faster than the individual method. Ruddy ducks readily cleaned their feathers even while being observed at close range. Some of the other species were more reluctant to clean themselves. An enclosed cleaning tank with one-way glass would probably improve this technique.

Chesapeake Bay Oil Spills

On 1 February 1976, a barge sank near Smith Point, VA and spilled 250,000 gallons of oil into Chesapeake Bay. Two years later another barge sank at the same location spilling 25,000 gallons of oil. The circumstances of these 2 spills were remarkably similar. In the 1976 spill, horned grebes and oldsquaw comprised 85% of the known losses, whereas in the 1978 spill, 68% of the losses were oldsquaw, goldeneye, and scaup (Table 3). Thirty other bird species died as a result of the oil spills.

The known mortality from the 1976 spill was 10,310 birds which included 1841 birds that were recovered alive but subsequently died. Most (81%) of the birds were found on the eastern shore of Chesapeake Bay because of strong northwesterly winds which prevailed for many days following the spill. Although horned grebes represented 45% of the total mortality, only 18% of oiled birds found alive were horned grebes.

Attempts to clean birds found alive in the 1976 spill were very disorganized. Federal and state biologists were not involved in the cleaning of birds from this spill and most work was done by concerned volunteers working through humane societies and local veterinarians. As in other spills, many cleaning agents were used in an attempt to find a suitable way to clean birds. Solvents were used at first, but their use was terminated when high mortality during cleaning was observed. Detergents were used to clean most of the birds, but wetting of feathers was a problem as in the past. Very few birds were released to the wild and mortality of birds that underwent cleaning was probably close to 100%.

The 1978 oil spill affected mainly oldsquaw, goldeneye, and scaup. An estimated 10,000 birds died (2000 known dead) from this spill and only 423 birds were recovered alive. Cleaning techniques, holding facilities, and care of the birds were better than any of the previously mentioned spills. One hundred thirty-seven of the treated birds were released on 1 April 1978, which was a high percentage compared to the other spills. Residues of oil were seen on some birds and many birds appeared to have wet feathers. Twenty-three of the released birds died during or within 7 days of release leaving 114 (27%) birds whose fate was unknown.

CONCLUSION

Attempts to clean birds oiled after 5 major oil spills on the Delaware River and 2 major oil spills on Chesapeake Bay demonstrated numerous problems associated with rehabilitating oiled birds. Ruddy ducks are the predominant water birds wintering on the tidal Delaware River and they encountered the most significant losses. In Chesapeake Bay a greater variety of oiled birds were found, but horned grebes and oldsquaw had the greatest losses. Horned grebes appeared to be especially vulnerable to oil as they made up a much larger percentage of dead birds than oiled live birds.

Rehabilitation was attempted on 3113 birds which represents 6% of the estimated 52,500 birds believed dead from these spills. Solvents were extremely toxic as a cleaning agent for birds, especially ruddy ducks. Detergents were effective in removing light crude oil and small amounts of heavy crude oil. However, most detergents that were effective in removing oil contained a surfactant that remained in the feathers for long periods after cleaning. These surfactants caused wetting of the feathers and subsequent mortality when birds were released. Greatest mortality for all cleaning agents occurred 24 hours after cleaning apparently due to toxicity of cleaning agents (solvents), hypothermia, and stress.

Hypothermia was the major mortality factor in all phases of rehabilitation of oiled birds. Birds lost their insulation due to oil fouling the feathers and then due to surfactants when they were cleaned. The most important factor in keeping oiled birds alive during rehabilitation is to protect them from temperature extremes. Birds should be maintained in rooms at temperatures of 24-30 C until feathers thoroughly regain waterproofing.

At present detergents are recommended to be used to remove oil from the feathers of birds. The selection of a detergent is based on the type of oil and other factors (Berkner et al. 1977). As a matter of policy, solvents are prohibited on any rehabilitation efforts that are supervised by the U.S. Fish and Wildlife Service (6 December 1977 memo from Director USFWS) because of the hazards posed to humans and birds from their flammable and toxic characteristics. Better techniques should be developed to eliminate the surfactant problem of detergents and to assure complete removal of heavy crude oil from feathers. Present cleaning techniques have been developed to handle birds individually, which is efficient only when small numbers of birds are to be treated. Individual treatment of birds involves excessive handling by volunteers who are inexperienced in bird handling techniques. More research is needed to develop a cleaning procedure where birds can clean and rinse themselves with limited human handling. The ultimate goal of oiled bird rehabilitation is to capture the victims as quickly as possible, clean them of all oil, and return them to their natural environment with minimum mortality.

However, the most obvious solution to the oiled bird problem is the elimination of oil spills. Much progress has been made toward this goal by (1) prohibition of dumping waste oil at sea, (2) imposition of heavy fines on companies or individuals responsible for oil spills, (3) emphasis on improved safety measures, and (4) development of sophisticated oil control and cleanup procedures after spills. In spite of these measures, spills continue to occur and birds are lost. For this reason there is a real need to develop rehabilitation methods that are both biologically effective and economically feasible. Unless such techniques are developed, major efforts at rehabilitation do not seem productive.

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