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ABSTRACT

A wide range of techniques are available for deterring birds from coastal oil spills, including (but not limited to) pyrotechnics, aircraft, boats, flags, reflecting devices, and artificial sounds. Many of these deterrent devices have had little field testing to determine optimal deterrent strategies. The Marine Spill Response Corporation (MSRC) developed a research and development (R&D) plan which has identified critical research which would need to be conducted to determine these optimal strategies. This program was initiated through the generation of a report which described the state-of-the-art of deterring birds from marine oil spills. Following this report, MSRC hosted a workshop consisting of deterrent experts and practitioners from the private and public sectors. This panel determined priority areas of marine oil spill bird deterrent R&D. A group consisting of research personnel from government and industry are currently involved in implementing a high-priority R&D project as identified by the deterrent workshop panel. The present paper describes these research efforts.

KEY WORDS

birds, oil, spills, deterrents

INTRODUCTION

Birds which frequent water bodies (known in this context as "waterbirds") are at an elevated risk of experiencing oil contamination from petroleum spills due to their proximity to tanker routes, offshore platforms, and coastal bulk oil storage facilities. Manifestations of oil contamination on waterbirds include loss of buoyancy and hypothermia (from fouling of plumage); a number of systemic disorders including hemolytic anemia and pneumonia (from oil ingestion); and, in terms of reproductive disorders, cessation or reduced number of eggs produced, egg mortality, and nest abandonment (RPI International, Inc. 1988). The vulnerability of a given water bird species to spilled oil relates to differences in behavioral patterns, distribution, and reproduction. For example, waterbirds which form large flocks and tend to spend extensive periods of time roosting or feeding on the water are considered to be highly vulnerable to spilled oil. Waterbirds that produce small clutch sizes also are considered to be vulnerable since their population will require longer periods of time to recover from mass mortalities.

When an oil spill threatens local waterbird stocks, two major options are available to response personnel: (l) oiled waterbird rehabilitation, and (2) deterrence of unoiled waterbirds from the zone of contamination. Often these techniques are used in tandem at oil spills. A number of traditional bird deterrent techniques (e.g., propane cannons) are deployed in an area of concern. Birds which persist in the area and become contaminated are then subject to rehabilitation efforts (i.e., retrieval, cleaning, recovery, and release). Unfortunately, current deterrent techniques have had only limited effectiveness. Furthermore, bird rehabilitation efforts tend to be highly stressful to the captured animal and have had highly varying degrees of success. Consequently, a review of deterrent and cleaning operations at past oil spills has yielded two observations: (1) effective waterbird deterrence capabilities are limited, and (2) rehabilitation efforts are inherently stressful on birds since these operations are predicated on the fact that a bird has already been contaminated (hence, experiencing varying degrees of adverse impacts as described above) and requires direct human intervention. Conversely, bird deterrent devices, if effective, offer a means of keeping birds from contaminated zones without the additional stresses of direct human handling and rehabilitation.

A research and development (R&D) program was initiated by the Marine Spill Response Corporation (MSRC), a nonprofit oil spill response organization, in the area of waterbird deterrence from marine oil spills. The program has focused on (l) a state-of-the-art survey of waterbird deterrent techniques, (2) a workshop which identified priority bird deterrent techniques, and (3) a waterbird deterrent field study in New Brunswick, CN.

STATE-OF-THE-ART SURVEY

A state-of-the-art survey entitled "Waterbird Deterrent Techniques" (MSRC Technical Report Series No. 94–003) was conducted by Greer and O'Connor (1994). The survey was a cooperative project between Exxon Biomedical Sciences, Incorporated, and MSRC. The report summarized information and research on deterrent techniques for waterbirds with emphasis on those techniques that have been used, developed, or experimentally tested for oil spill application. The report also summarized terrestrial devices and methods that may hold potential for deterring waterbirds from wetland, coastal, and marine habitats. Deterrent devices and application strategies were presented for waterbird species, species groups, and habitats. Also, safety issues, regulatory concerns, and environmental considerations were addressed. Examples of equipment suppliers were provided. Waterbird deterrent techniques for oil spill applications are summarized in Table 1.

DETERRENT RESEARCH WORKSHOP

Once a clearer understanding of the state-of-the-art in waterbird deterrent techniques was accomplished, a workshop was convened to identify and prioritize appropriate areas of waterbird deterrent R&D. Waterbird deterrent experts from government, industry, and academia attended

Table 1. Summary of Waterbird Deterrent Techniques for Oil Sprill Application (Greer and O'Connor 1994)

Deterrent Device	Most Effective With These Species	Reporter Advantages	Reported Disadvantages
Gas-operated Exploders	Waterfowl, gulls, herons, seabirds (?)	Limited manpower, compliment other devices	Must be moved frequently
Pyrotechnics	Waterfowl, gulls, herons	Standard technique, compliment other devices	Safety/fire hazard, labor intensive
Aircraft	Waterfowl, gulls, herons, seabirds	Large area covered, limited manpower, direction controlled	Expensive, hazard of bird-aircraft colision
Boats	Waterfowl, possibly seabirds	Large area covered, limited manpower, direction controlled	Weather/sea condition constraints
All Terrain Vehicles	Waterfowl, shorebirds	Reach inaccessible areas	Marsh habitat disturbance
Electronic Sound Generators	Geese, gulls, seaducks (?)	Effectiveness largely untested	Effectiveness largely untested
Air Horns	Waterfowl, gulls	Inexpensive	Rapid habituation
Biosonics	Gulls, some herons	Slow habituation	Highly species-specific
Underwater Acoustics	Unknown	Effectiveness unknown	Effectiveness unknown
Ultrasonic	None	None	Ineffective
Balloons	Waterfowl	Inexpensive	Rapid habituation, daytime only
Flags	Waterfowl	Inexpensive, materials readily available	Rapid habituation, daytime only
Lights	Waterfowl, gulls, some herons	Inexpensive	May attract birds, night only
Mirrors, Reflectors, Reflecting Tape	Waterfowl, gulls, some herons	Inexpensive	May attract birds, night only
Human Effigies and Predator Models	Waterfowl	Inexpensive	Rapid habituation
Trained Falcons and Hawks	Waterfowl, gulls	No habituation	Expensive, daytime only, may cause birds to dive into oil
Decoys	Waterfowl, gulls	Inexpensive	Must be moved frequently, daytime only
Dyes	Unknown	Effectiveness unknown	Effectiveness unknown
Lure Areas	Waterfowl	Passive	May attract birds to spill area

the November 1994 workshop. A ranked set of R&D priorities can be found in the workshop proceedings (MSRC Technical Report Series No. 94-006) and in Table 2 of the present paper.

The number one and two priorities in Table 2 are both sound emitting devices which are designed to limit waterbird habituation through the emissions of differentiating sound patterns. The Phoenix Wailer is stationary and may be deployed either on land or on the water. The floating version of the Phoenix Wailer is known as the "Marine Wailer." The Environment Canada Buoy moves with floating oil slicks. Sensory aversion research addresses deterrence through taste sensory receptors. An example of this method is the use of the chemical compound methyl anthranilate (used in certain human food products as grape flavoring). Methyl anthranilate has been used in the past to deter birds from landfills and public parks. Traditional strategies used in bird deterrent operations (e.g., propane cannons and cracker shotgun shells) require the development of protocols for improved effectiveness. Workshop participants agreed that one method of increasing effectiveness was to establish a national standardized reporting system for capturing operational lessons learned during each deterrence operation. Sound aversion research was suggested as one way to increase deterrence effectiveness. This research would focus upon avian physiological mechanisms which elicit a scare or irritant response in birds. A deterrence technique that the workshop deemed worthy of further research was to determinethe feasibility of electronically mimicking bird distress and alarm calls. Other R&D priorities include identifying technologies outside the realm of wildlife protection for potential use in deterrents, developing public relations/outreach issues, and gaining an understanding of the effects of seal bombs on both waterbirds and subtidal resources.

Table 2. Research Priorities on Bird Deterrent Techniques (after Thomas 1994)

Ranking	Research Topic
1	Phoenix Wailer
2	Environment Canada Prototype Buoy
3	Sensory Aversion
4	Traditional Strategies/Techniques
5	Standardized Reporting
6	Sound Aversion Research
7	Distress and Alarm Calls
8	Developing Technologies
9	Public Impact
10	Seal Bomb

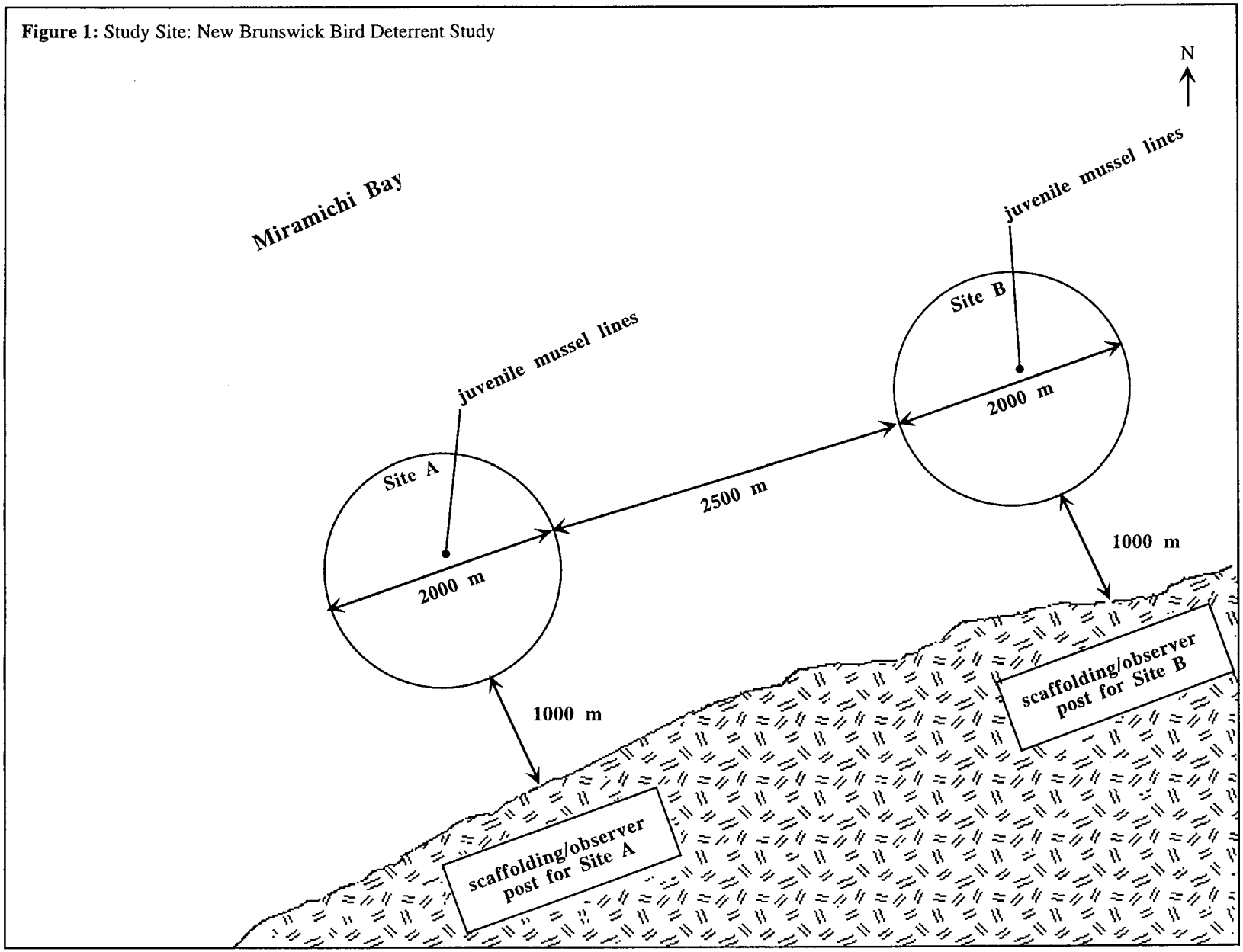
NEW BRUNSWICK BIRD DETERRENT FIELD STUDY

Based upon the number one research priority identified by the participants at the workshop (i.e., Phoenix Wailer research), MSRC, in concert with the Texas General Land Office, and Ron Hounsell (Canadian Wildlife Service, Retired), have initiated a field study. The study will be conducted in October 1995 in Miramichi Bay, New Brunswick. The objectives of the study will be to determine the Marine Wailer's (1) areal extent of waterbird deterrence, (2) length of time required to deter birds from the test site, and (3) length of time that deterrence operations are effective. Concurrently with these test objectives, the research team will conduct an operational feasibility study geared towards oil spill (i.e., emergency) response considerations. Issues addressed include transportation, assembly, deployment, and maintenance considerations. Adverse effects associated with the operation of the Marine Wailer will also be noted (e.g., noise pollution). These objectives are designed to define the "response niche" of the Marine Wailer in spill response operations—i.e., under what conditions should the Marine Wailer be employed in waterbird deterrence operations following an oil spill.

In order to test the effectiveness of the Marine Wailer in waterbird deterrence, two marked sites have been constructed on the water north of Bay Du Vin Island in Miramichi Bay, New Brunswick (Figure 1). Each circular site is 2,000 m in diameter. Color-coded buoys radiate from the center of each site, marking off 100 m, 200 m, 300 m, 400 m, 500 m, 700 m, and 1,000 m annuli. At the center of each site are six lines of tethered juvenile mussels. Hundreds of approximately 1-cm long mussels are tethered to each line. These lines are secured to the sea floor and extend to the surface of the water. During their fall migration, scoters (common and surf), eiders, and mergansers (common and red-breasted) heavily predate these mussel lines. Accordingly, the mussel lines serve as a strong attractant to these waterbird species. This scenario provides a worst case for bird deterrent operations: if birds can be repelled from an attractant (i.e., food), it is believed that they will be effectively repelled from an oil-contaminated area. The Marine Wailer will be deployed in one of the two sites, serving as the "treatment" site. A Marine Wailer will not be deployed at the control site. The null hypothesis for the study is that there is no significant difference in the areal distribution of common scoters, surf scoters, eiders, common mergansers, and red-breasted mergansers in a circular area with a diameter of 2,000 m with and without a Marine Wailer bird deterrent device.

The study is divided into three phases: a prestudy, study, and poststudy. During the prestudy, observers stationed on scaffolding on Bay Du Vin Island (Figure 1) will observe the distribution of birds in the control and treatment sites for 1 hr at dawn and dusk daily for 5 days. During the prestudy, the Marine Wailer will not be engaged. This will allow for a baseline count of birds in both study sites. The study will begin the day after the close of the prestudy. The 21-day study will be initiated by the engaging of the Marine Wailer. Twice daily bird counts in the two study areas will proceed as described in the prestudy. The Marine Wailer will be engaged during the entire duration of the study. Following the cessation of the study, a 5-day poststudy will be conducted. The post study will be conducted in an identical manner to the prestudy (i.e., the Marine Wailer will be turned off). The poststudy will allow for bird distribution observations following the disengaging of the Marine Wailer.

Figure 1: Study Site: New Brunswick Bird Deterrent Study



Collected bird count data will undergo a statistical analysis to determine if any significant differences exist in bird distributions in the presence and absence of the Marine Wailer.

FUTURE RESEARCH

Additional studies which address the priority R&D topics identified in this paper are required. These studies are needed to increase the effectiveness of waterbird deterrent operations in future spills.

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