Aquacultural Engineering 40 (2009) 87–94

Contents lists available at ScienceDirect

Aquacultural Engineering

journal homepage: www.elsevier.com/locate/aqua-online

Deterring coastal birds from roosting on oyster culture gear in eastern New Brunswick, Canada

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ARTICLE INFO

Article history:
Received 20 August 2008
Accepted 17 November 2008

Keywords:
Crassostrea virginica
Oyster
Aquaculture
Phalacrocorax auritus
Cormorant
Roosting
Birds

ABSTRACT

An ornithological survey was conducted along the eastern coastline of New Brunswick, Canada, where oysters are cultivated in suspension using PVC bags and wire-mesh cages. Thirteen bird species and a variety of unidentified shorebirds were observed roosting on the floating oyster gear. The double-crested cormorant (*Phalacrocorax auritus*) was the most common species observed (47.6% of all counts), closely followed by herring gulls (*Larus argentatus*) and common terns (*Sterna hirundo*) at 18.7% and 13.0%, respectively. Birds were densely aggregated where few cages or bags had been deployed. A gear-type effect was also detected: birds were more abundant on floating cages (mean = 47.9/100 m^2 of exposed area, S.E. = 5.8) than on floating bags (mean = 32.8/100 m^2, S.E. = 1.9). The survey was followed by two experiments designed to test the effects of gear modifications on bird abundance and diversity. For bags, results indicated that shallow immersion (~6 cm below surface) and floater instability were effective deterrents to *P. auritus*, reducing its abundance by a 37-fold factor. For wire-mesh cages, a dented triangular structure mounted on top of floaters was a harassing physical barrier to roosting behaviour, consequently reducing bird abundances to null (or near null) values.

1. Introduction

Communal roosting is a common behaviour in several species of social animals, including coastal birds (McGowan et al., 2006). This behaviour has evolved independently numerous times (Beauchamp, 1999; McGowan et al., 2006) and is thought to positively impact several species of seabirds (Roycroft et al., 2007) by enhancing the sharing of information (Ward and Zahavi, 1973; Ydenberg and Prins, 1984; Dall, 2002) and by promoting recruitment (Richner and Heeb, 1996; Dall, 2002). Roosting behaviour can also increase foraging efficiency, reduce predation risk and minimize thermoregulatory costs (Ydenberg and Prins, 1984; Beauchamp, 1999; McGowan et al., 2006). The behaviour has been studied extensively from an ecological perspective, providing a better understanding of roost choices (Luìs et al., 2001; Rogers, 2003; Rogers et al., 2006), species distribution (King, 1996; Bugoni and Vooren, 2005; Dittman et al., 2005) and hierarchical dominance in roosting populations.

From an aquaculture perspective, however, communal roosting is considered a nuisance. Birds predate on cultured fish stocks (Jenkins and Smith, 1998; Dorr et al., 2004; King, 2005), and their presence also raises other concerns, such as water contamination by faecal coliforms (Kirschner et al., 2004; Kuntz et al., 2004; Bucio et al., 2006), propagation of pathogenic agents (Flowers et al., 2004; Overstreet and Curran, 2004; Mitchell et al., 2005), and organic enrichment of sediments (Powell et al., 1991). Several bird-deterring techniques have been suggested in the literature (see review by Mott and Boyd, 1995). These methods include scaring effigies (Stickley et al., 1995; Seamans, 2004), repelling chemicals (Cotterill et al., 2004; McWilliam and Cheke, 2004; Harpaz and Clark, 2006), fencing and netting (Mott and Flynt, 1995; Nemtzov and Olsvig-Whittaker, 2003), harassment devices (Mott et al., 1998; Tobin et al., 2002), and the more-drastic solution of hunting (Bechard and Marquez-Reyes, 2003; McWilliam and Cheke, 2004).

In New Brunswick, Canada, oyster (*Crassostrea virginica*) farming is carried out in approximately 15 embayments (Fig. 1). Suspended culture, in which oysters are held inside floating PVC bags or floating cages (Fig. 2), is the predominant farming technique. In winter floaters are removed to lower stocks onto the bottom where they are protected from the thick ice. At other times, however, stocks are suspended at the surface in a relatively

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doi:10.1016/j.aquaeng.2008.11.003

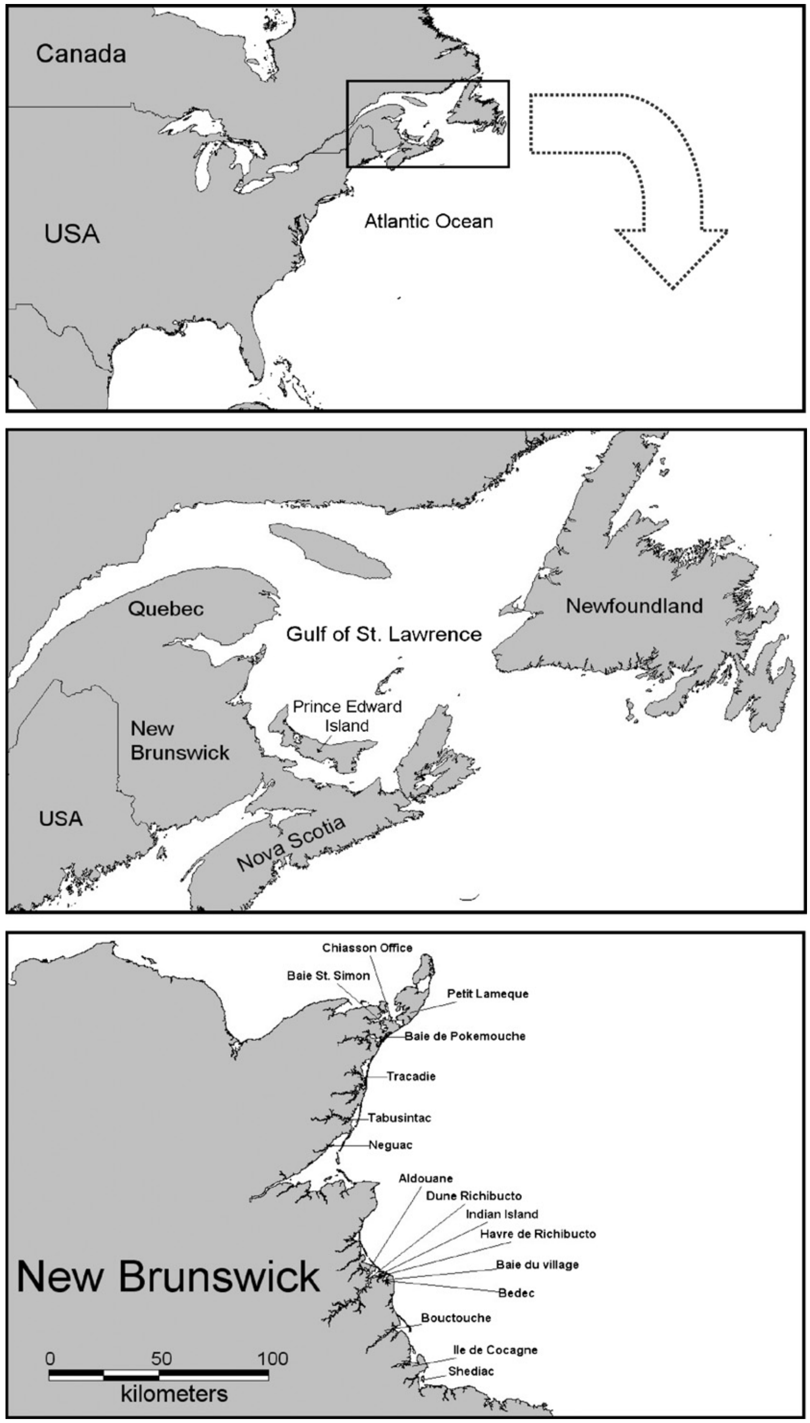

Fig. 1. Map of study area showing oyster farming sites in New Brunswick.

warm and phytoplankton-abundant environment, thereby enhancing shell growth and shortening the production cycle. When at the surface, stocks are easily accessible to growers for harvesting and grading procedures; moreover, the suspended bags or cages can be flipped and temporarily exposed to air, thereby desiccating biofoulers. The entire technique for suspending and flipping bags and cages has been developed in New Brunswick in the late 1990s.

Floating gear, on the other hand, provides substantial roosting areas for coastal birds. In 2004, Canadian food safety and fisheries agencies have requested that all oysters contained in floating bags or cages be depurated prior to harvest. The precautionary depuration procedure requires the transfer of suspended stocks onto the bottom 30 days prior to harvest (14 days if stocks are subsequently tested for coliforms as required by the Canadian Shellfish Sanitation Program, 2005). The new regulation increases both labour and time needed to complete the production cycle. Consequently, there is a growing interest in developing new floating gear designs that could prevent birds from roosting in oyster farms. The underlying rational is that effective bird-deterring designs would ultimately be exempted from the regulation pertaining to depuration.

In this paper, we begin by reporting results from an ornithological survey conducted in NB oyster farms. We identify bird species and report on their abundance in relation to current

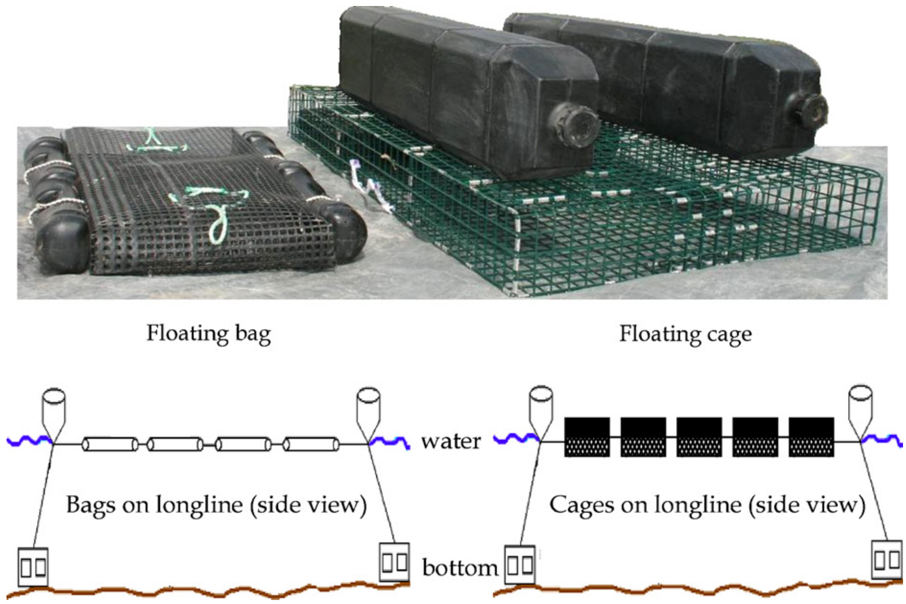

Fig. 2. Floating gear types currently present in New Brunswick oyster farms. The trademark for the floating cage is OysterGro®, manufactured by Bouctouche Bay Industries Ltd. in New Brunswick.

floating gear designs. The survey was followed by two field experiments examining the effects of gear modifications on bird abundance and diversity.

2. Methods

2.1. Survey

In September and October 2005, 15 embayments along the eastern coastline of New Brunswick were visited. The location of each embayment is identified in Fig. 1. A total of 22,600 floating bags and 4609 floating cages were examined for the presence of birds. Bird observations were carried out either from land or from a kayak using binoculars and a spotting scope. Only birds perching on oyster gear and any associated buoys were identified and counted. Bird counts reflect the maximum number of individuals seen at any one time during a disturbance-free period of 15 min. All counts were carried out between 10 a.m. and 4 p.m. A subsequent analysis indicated that the time of day had no significant effect on bird counts.

It is also important to note that the surface areas available for roosting differ according to gear type. For a floating bag, which has two small floaters and one PVC bag that are exposed and available for roosting, this area is approximately 0.35 m^2. For a floating cage, the available roosting area provided by the two large floaters is 0.45 m^2; the wire-mesh cage itself is too deep—12 cm below surface—to provide a roosting surface. In keeping with this information, counts were standardized as the number of birds per 100 m^2 of available (exposed) roosting area.

2.2. Floating bag experiment

In 2006, three different types of floating bags were deployed within an experimental setting. The first type consisted of standard bags (S) with lateral floaters typical of those in current use by most growers (Fig. 3a). For the second type, the S configuration was modified by positioning the two side floaters onto the top of the bag, thereby allowing the bag to sink approximately 3 cm below the water surface (Fig. 3b). While the two floaters remain a potential perching platform for birds, the area they offer to birds is less than 20% that of the unmodified bag. This modification was termed M1. In a second modification (M2), the S configuration was modified by positioning the two side floaters on top of the bag, but the bag itself was lowered approximately 6 cm below the surface using loose rope (Fig. 3c). The loose rope between the floaters and the bag rendered the floaters unstable.

The experimental bags were deployed in three embayments: Chiasson Office, Néguac, and Richibucto (see Fig. 1). At each of these sites, three longlines were deployed equidistantly (6.1 m) as illustrated in Fig. 4. Each longline held 11 floating bags per type (S, M1 and M2), which were dispersed in groups of three bags (except at the end of the longline where space was lacking and where grouping was limited to two bags). Details regarding bag layout are of no consequence since the entire longline itself was considered the statistical unit. For that reason, a single bird count (per bag type) was performed for each experimental longline. Bird counts represent the maximum number of individuals seen at any one time during a 1-h period. Counts were standardized to the number of birds per 100 bags. Species richness represents the number of different species observed during the count period. All observations were carried out at bi-monthly intervals between August 28 and November 7, 2006.

Data were partitioned into five 2-week intervals. Factors for each variable were analysed using a complete randomized block design with repeated measures according to gear type (fixed between-subjects factor with three levels [M1, M2 and S]), sites (fixed between-subjects factor with three levels [Chiasson Office, Néguac, and Richibucto]), sampling time (random factor with five levels of repeated measurements) and all their mutual interactions. Mauchly's test ($\alpha = 0.05$) was used to assess whether datasets conformed to the sphericity assumption required for a repeated measure analysis. When the sphericity assumption was not met, the degrees of freedom were adjusted accordingly using the Huynh–Feldt correction. Significant differences between all possible combinations of sample means for gear type were also assessed using Tukey's HSD test ($\alpha = 0.05$). All analyses were performed with SPSS 10.0 for Windows© (SPSS Inc., Chicago, IL, USA).

2.3. Floating cage experiment

Bouctouche Bay Industries Ltd. has developed the AntiCormo (AC), a bird-deterrent structure that can be fitted easily onto

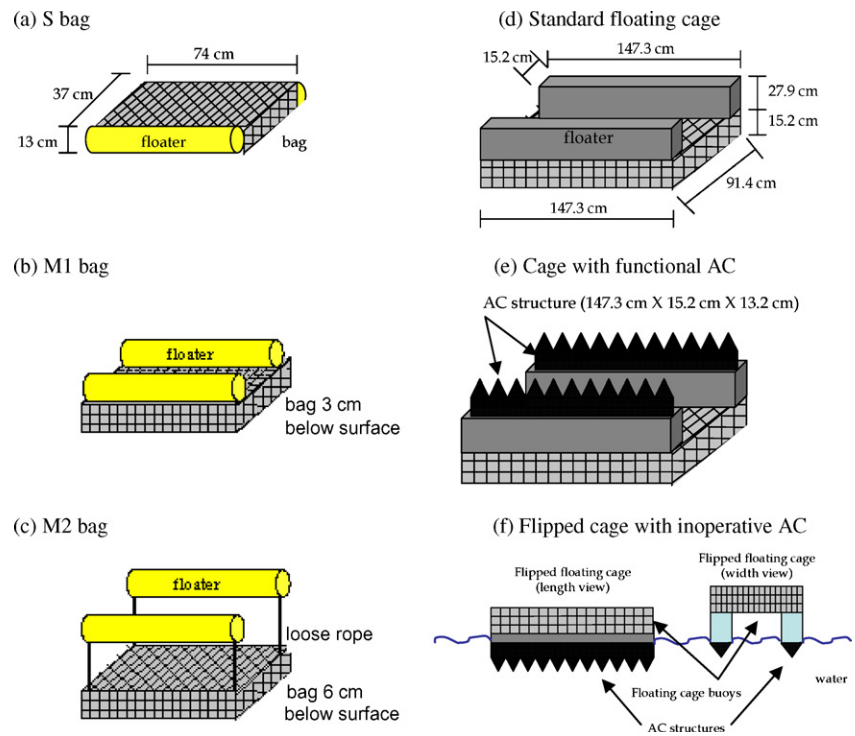

Fig. 3. Floating gear prototypes tested in the present study.

floating cages as illustrated in Fig. 3e. Taking into account the ability of birds to adapt over time, our goal in this experiment was to assess the effectiveness of the AC in deterring birds over an extended period. Our experimental approach was based on the full conversion of two farms and monitoring of bird abundance over an 18-week period (July 1 to November 3, 2007). One farm was located in Shediac Bay and contained a total of 140 floating cages (14 longlines of 10 cages); the second farm was located in Bouctouche Bay and held 100 cages (10 longlines of 10 cages). The two farms were selected because they were isolated, with the closest commercial aquaculture activities located at a distance of 5–10 km. The presence of bird colonies near the experimental farms was verified using two approaches: (1) by removing the AC devices at the start and completion of the experiment, and (2) by occasionally flipping cages and rendering the AC non-functional (i.e., underwater, as illustrated in Fig. 3f).

Once a week, bird counts were performed from land using a spotting scope. Counts were limited to four randomly selected longlines (the statistical unit). The count period consisted of four consecutive 15-min intervals. Data corresponding to the interval with the maximum number of individuals of the same species were kept for analysis. Descriptive statistics, including the standardized bird abundance per 100 floating cages, were computed for each experimental site.

3. Results

3.1. Survey

Thirteen bird species and a variety of unidentified shorebirds were observed roosting on floating oyster gear (Table 1). The most common species was the double-crested cormorant (*Phalacrocorax auritus*), representing almost half (47.6%) of all counts. Behaviourally, *P. auritus* was observed perching and preening, as well as drying its wings. Herring gulls (*Larus argentatus*) and common terns (*Sterna hirundo*) were also often spotted (18.7% and 13.0% of all counts).

Bird abundance was inversely correlated with the total roosting area made available by the floating gear (Fig. 5). The highest abundances, indicating a high degree of aggregation, were recorded at sites containing relatively few bags or cages. In keeping with these results, bird abundances were normalized to remove the effect of available roosting area. Following this correction, we found that birds were more abundant on floating

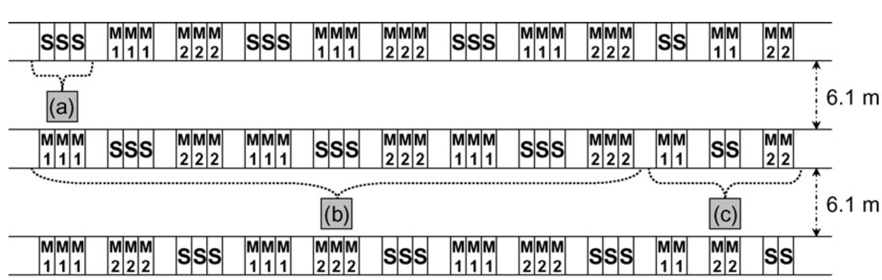

Fig. 4. Example layout of three experimental longlines holding three types of floating oyster bags: standard (S), first modification (M1) and second modification (M2). (a) Group of three bags of the same gear type. (b) Nine groups of three bags laid out in a random order. (c) End of experimental culture line with three groups of two bags laid out in a random order.

Table 1
Bird species surveyed at commercial oyster farming sites in New Brunswick.

Common name	Latin name	Total counts	% Total count
Double-crested cormorant	*Phalacrocorax auritus*	1588	47.6
Herring gull	*Larus argentatus*	624	18.7
Common tern	*Sterna hirundo*	435	13.0
Black-bellied plover	*Pluvialis squatarola*	160	4.8
Dunlin	*Caldris alpina*	146	4.4
Greater black-backed gull	*Larus marinus*	117	3.5
Immature gull	*Larus* spp.	70	2.1
Bonaparte's gull	*Larus philadelphia*	52	1.6
Ringed-billed gull	*Larus delawarensis*	51	1.5
Shorebirds spp.	*Caldris* spp.	28	0.8
Red-breasted merganser	*Mergus serrator*	23	0.7
Black duck	*Anas rubripes*	9	0.3
Greater yellowlegs	*Tringa melanoleuca*	8	0.2
Great blue heron	*Ardea herodias*	6	0.2
Lesser yellowlegs	*Tringa flavipes*	1	0.0
All species		3318	100.0

cages (mean = 47.9/100 m^2, S.E. = 5.8) than on floating bags (mean = 32.8/100 m^2, S.E. = 1.9) ($P < 0.001$, Mann–Whitney).

3.2. Floating bag experiment

Table 2 summarizes the outcome of the floating bag experiment. Gear type, which is the key factor of interest in the present investigation, was the only factor that yielded a significant effect on species richness in the main effects category. Moreover, gear type showed no interactions with sampling time, indicating that the effect on species richness was consistent through time. Similar effects were detected on bird abundance. Gear type exerted a significant influence on abundance and there was no interaction between gear type and sampling time. The same outcome was obtained whether all species were grouped or *P. auritus* was analysed separately. By contrast, no gear effect was found when analysing other species (e.g., *Larus* spp.) separately.

Fig. 6 shows mean species richness (panel A) and abundance (panel B) in relation to gear type. Post hoc analyses (Tukey's HSD) indicated that gear-type effects were attributable to differences between S and M2 bags. On average, species richness for S bags was approximately seven times higher than for M2 bags. A total of nine species were seen roosting on S bags throughout the duration of the experiment compared to only two species for M2 bags (*P. auritus* and *Larus marinus*). S bags also attracted a greater number of *P. auritus* compared to M2 bags. Average standardized abundance of *P. auritus* was approximately 37 times greater on S bags than on M2 bags.

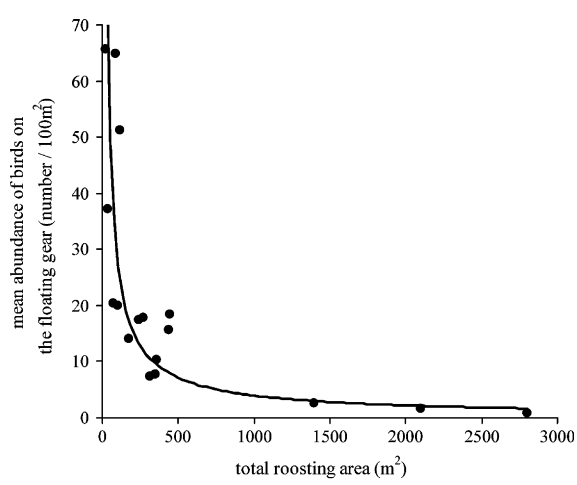

Fig. 5. Relationship between bird abundance and the roosting area made available by floating oyster gear. The solid line is a power-fit to the following function: $y = 1388.5x^{-0.8487}$ ($r^2 = 0.82$, $P < 0.001$). Data points represent the mean values of several sampling dates for individual sites.

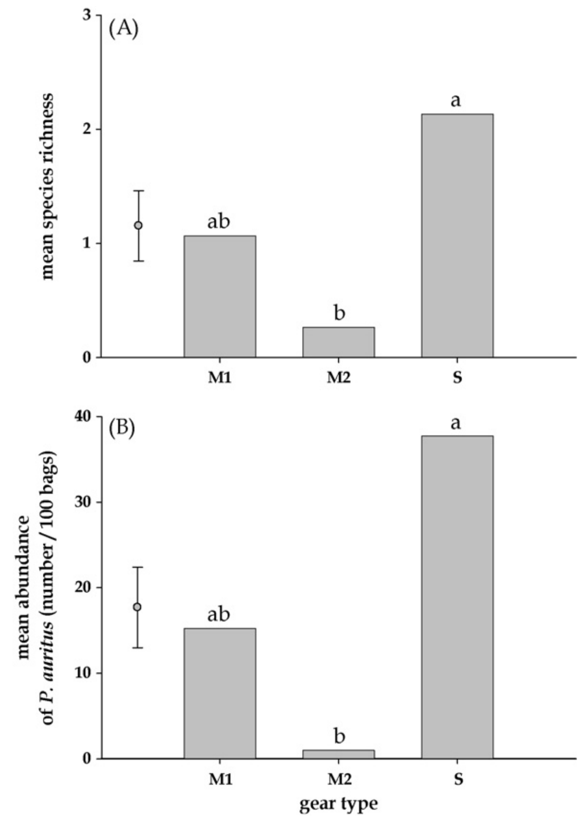

Fig. 6. Mean species richness (a) and abundance (b) of birds roosting on floating bags of type S (standard), M1 (first modification) and M2 (second modification). Means are presented with a single error bar provided by the standard model error (SME). Bars with different letters differ significantly from each other (Tukey's HSD).

3.3. Floating cage experiment

Fig. 7 shows the abundance time-series for the two experimental sites. At the Shediac site, AC structures were absent on several occasions (weeks 1–4, 15, 17 and 18); during these periods, abundance varied between 100 and nearly 500 birds per 100 floating cages. Abundance was also elevated at times when AC devices were inoperative due to the flipping of cages. Similar results were obtained at the Bouctouche site, with the exception that no birds were spotted in week 4 when the AC structures were absent. A total of 2195 individuals and 5 species (*P. auritus*, *L. argentatus*, *L. marinus*, *S. hirundo* and *Ardea herodias*) were identified at the two experimental sites; *P. auritus* was the dominant species, accounting for nearly 85% of all counts; *S. hirundo* and *L. argentatus* were also regularly spotted, with each species accounting for approximately 7% of all counts. Together these observations indicate that the two experimental sites were appropriate for testing the AC device.

Floating cages equipped with functioning AC devices attracted fewer birds. Weekly abundance estimates varied between 0 and 1.25 (S.E. = 0.72) birds per 100 floating cages at the Shediac site. During a 13-week period, only two individual birds, one *P. auritus* and one *L. argentatus*, were seen at this site. A total of 146 birds were spotted at the Bouctouche site, and weekly abundance

Table 2
Summary of a complete randomized block with repeated measures carried out on four variables: species richness, abundance of all species, abundance of *P. auritus*, and abundance of *Larus* spp.

Source of variation	d.f.	SS	Adjusted d.f.[a]	MS[b]	*F*	P[c]
(a) Species richness						
Site (S)	2	5.91	–	2.96	2.08	0.241
Gear type (G)	1	26.31	–	13.16	9.25	**0.032**
Between-subjects error	4	5.69	–	1.42	–	–
Time of sampling (T)	4	1.47	–	0.37	0.82	0.534
T × G	8	0.80	–	0.10	0.22	0.981
T × S	8	6.53	–	0.82	1.82	0.148
Within-subjects error	16	7.20	–	0.45	–	–
Total	44	53.91	–	–	–	–
(b) Abundance all species						
Site (S)	2	6019.38		3009.69	4.38	0.098
Gear type (G)	2	14181.00	–	7090.50	10.32	**0.026**
Between-subjects error	4	2745.84	–	686.46	–	–
Time of sampling (T)	4	4018.77	–	1004.69	5.33	**0.006**
T × G	8	2549.94	–	318.74	1.69	0.176
T × S	8	4730.53		591.31	3.13	**0.025**
Within-subjects error	16	3014.79	–	188.42	–	–
Total	44	37260.25	–	–	–	–
(c) Abundance of *P. auritus*						
Site (S)	2	4150.17	–	2075.08	4.00	0.111
Gear type (G)	2	10280.67	–	5140.33	9.91	**0.028**
Between-subjects error	4	2074.46	–	518.61	–	–
Time of sampling (T)	4	4878.04	3.24	1503.75	3.35	**0.050**
T × G	8	4317.36	6.49	665.46	1.48	0.257
T × S	8	8493.23	6.49	1309.10	2.92	**0.048**
Within-subjects error	16	5817.84	12.98	448.37	–	–
Total	44	40011.77	–	–	–	–
(d) Abundance of *Larus* spp.						
Site (S)	2	880.13	–	440.07	1.39	0.348
Gear type (G)	2	1846.76	–	923.38	2.92	0.165
Between-subjects error	4	1264.04	–	316.01	–	–
Time of sampling (T)	4	71.36	3.37	21.17	0.58	0.654
T × G	8	76.06	6.74	11.28	0.31	0.933
T × S	8	255.65	6.74	37.92	1.05	0.444
Within-subjects error	16	489.10	13.48	36.28	–	–
Total	44	4883.10	–	–	–	–

[a] Adjusted degrees of freedom (Huynh–Feldt correction) where the sphericity assumption is not met, $\alpha = 0.05$.
[b] Computed with adjusted degrees of freedom where available.
[c] Bold font indicates significance, $\alpha = 0.05$.

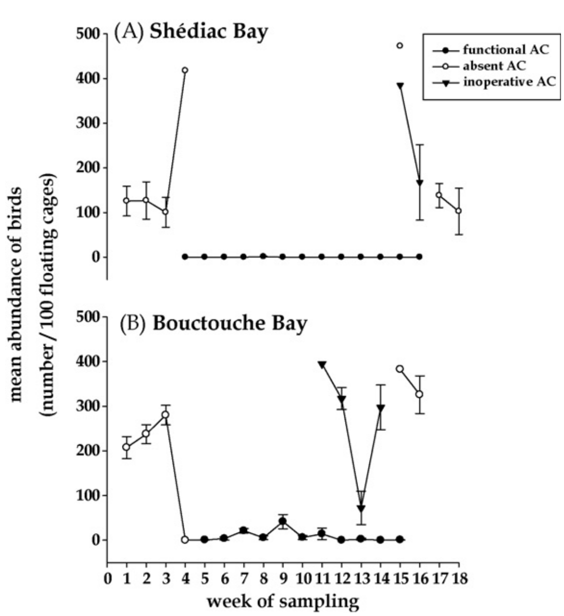

Fig. 7. Mean abundance (±S.E.) of birds roosting on experimental cages in Shediac (A) and Bouctouche (B). The time-series extends from July 1, 2007 (week 1) to November 3, 2007 (week 18).

estimates ranged from 0 to 41.9 (S.E. = 15.9) birds per 100 floating cages. There were no indications that birds progressively adapted (i.e., no increase in abundance over time) to AC devices at either site.

4. Discussion

4.1. Survey

An extensive ornithological survey indicated the presence of 13 bird species roosting on floating oyster gear along the eastern coastline of New Brunswick. Three species—*P. auritus*, *L. argentatus* and *S. hirundo*—which together were responsible for 79% of all counts, clearly dominated. These species have well-established breeding areas along the eastern coastline of New Brunswick (Erskine, 1992). They prey mainly on fish and small marine invertebrates such as zooplankton. There are previous reports on bird interference with aquaculture operations, although these studies have focused exclusively on predation of cultured stocks, such as *P. auritus* preying on farm-raised channel catfish (*Ictalurus punctatus*) in the southern United States (King, 1996). In our study, it was apparent that birds used floating oyster gear as roosting platforms.

Regarding abundances, the survey indicated that birds were densely aggregated where few culture units had been deployed (as per the relationship presented in Fig. 5). This result implies that the bird nuisance perception is function of the farming activity level. For example, in New Brunswick, the number of floating bags within individual leases varies from approximately 100 to 12,481 units (Comeau et al., 2006). We estimate, based upon the relationship shown in Fig. 5, that the lower end of activity (100 bags) could attract approximately 24 birds over a small body of water ($\sim$700 m^2), whereas the peak activity level (12,481 bags) may attract 49 birds dispersed over a much larger body of water (150,000 m^2). In keeping with this comparison, the amount of floating gear within a culture lease is perhaps a key parameter to consider when modelling the potential risks of water contamination by birds.

Another factor that seems relevant is gear type. Our survey suggests that birds have a preference for floating cages. This result may be attributable to cage design: compared to floating bags, floating cages are relatively stable and offer a large roosting area, attributes that are compatible with the large size and gregarious nature of *P. auritus* (Hatch and Weseloh, 1999). Also, floating cages provide an elevated platform ($\sim$17 cm above the waterline) compared to floating bags ($\sim$2 cm above the waterline). After diving, *P. auritus* usually looks for an elevated spot to perch, where it can spread its wings to dry its feathers (Hatch and Weseloh, 1999).

4.2. Floating bag experiment

The goal of this experiment was to compare bird diversity and abundance in relation to three bag deployment strategies: (1) standard (S) deployment, with the top portion of bags floating above surface; (2) modified (M1) deployment, with bags completely submerged $\sim$3 cm under the surface; and (3) modified (M2) deployment, with bags submerged $\sim$6 cm under the surface. Significant differences in bird diversity were found only between S and M2 bags; of the nine species observed on S bags during the experiment, only two (*P. auritus* and *L. marinus*) were seen on M2 bags. Three factors likely contributed to the decrease in diversity on M2 bags: depth (6 cm) at which the bag itself was maintained, floater instability, and interactions with floating organic debris. In terms of bag depth, it is noteworthy that both *P. auritus* and *L. marinus* have long tarsi, averaging approximately 8 and 9 cm, respectively (The New Brunswick Museum); species that avoided M2 have comparatively short tarsi. An influence of depth is consistent with reports of coastal birds changing their roost location with rising tides (e.g., Luìs et al., 2001; Rogers, 2003; Rosa et al., 2006). The M2 modification also increased floater instability. Our field notes indicate that the roosting time was very short (seconds) when *P. auritus* and *L. marinus* successfully landed on the M2 floaters; it was also noted that other species attempted to roost on M2 floaters but failed and immediately flew away. Lastly, S and M2 bags interacted differently with floating debris. S bags were often covered with common eelgrass (*Zostera marina*), which can be uprooted following storm events; M2 bags were generally free of this marine plant. This observation appears relevant because *S. hirundo* was occasionally seen feeding on small invertebrates entangled within *Z. marina*.

With respect to abundance, the total counts on S bags were dominated by *P. auritus* and *Larus* spp. The experiment showed that M2 bags attracted significantly fewer *P. auritus*. The reason(s) for M2 selecting against *P. auritus* cannot be determined with certainty. As indicated above, it is known that *P. auritus* has a marked preference for elevated perches where it can spread its wings to dry its feathers (Hatch and Weseloh, 1999). Floater instability and the depth of M2 bags probably prevented this behaviour. Gulls, on the other hand, do not exhibit this behaviour, which may explain why none of the experimental bag types significantly reduced the abundance of *Larus* spp.

4.2.1. Floating cages experiment

In this experiment, the effectiveness of a bird-deterrent device, the AntiCormo developed by Bouctouche Bay Industries Ltd., was evaluated at two sites over an 18-week period. The AC can be fitted onto existing floating cages as shown in Fig. 3e. In the absence of the AC device, floating cages generally attracted several birds as was expected from earlier survey results. This outcome indicates that local breeding populations, essential for the testing of the AC device, were present at the two experimental sites.

The AC device considerably reduced the number of birds roosting on floating cages at both experimental sites, with mean abundance falling from several hundred birds per 100 cages to null (or near null) values. Field notes indicate that the highest abundances at the Bouctouche site (e.g., mean of 41.9 birds/100 cages, week 9) were mainly associated with improperly installed AC devices. There were no indications that the birds adapted to properly installed AC devices. Therefore it appears that the AC was a harassing physical barrier, comparable to metal spikes or prongs commonly mounted, for example, on top of navigation buoys, park lights and gutters.

It is noteworthy that floating cages are occasionally flipped to control biofoulers as part of normal husbandry procedures. Once flipped, AC structures are submerged and the entire wire-mesh cage is exposed to air, thereby desiccating biofoulers. In our study, birds quickly resumed their roosting activities at times when cages were flipped. In New Brunswick, growers flip cages three to five times per year, and the desiccation of biofoulers normally occurs over 48 h, after which cages are returned to their normal position and the AC devices resume their full functionality. Evidently, cage flipping should be avoided some time prior to oyster harvesting. The "no-flip" period could be as short as 14 days in cases where there is follow-up testing for coliforms (Canadian Shellfish Sanitation Program, 2005).

5. Conclusion

This report presented possible mitigation measures to prevent the roosting of birds in oyster farms along the eastern coastline of New Brunswick. For floating bags, results suggested that floater instability coupled with an immersion depth of approximately 6 cm (for the bag itself) were effective deterrents to birds. Depth and floater instability were achieved simply by attaching loose ropes between floaters and bags. However, we recognize that this deployment scheme may not represent a practical option for the industry, given that bags must occasionally be flipped and exposed to air in order to control (desiccate) fouling organisms. Hence it is unlikely that the bag prototypes tested in the present investigation will be adopted by the industry. To date, no practical design has been found for floating bags, although the reported information on bird behaviour in the present report is useful for ongoing research.

For floating cages, a dented triangular structure (AC) mounted on top of each floater was an effective deterrent to birds. Moreover, from a practical perspective, the AC does not interfere with normal husbandry procedures. New floaters, commercially produced by Bouctouche Bay Industries Ltd. (New Brunswick, Canada), incorporate the AC (USA Patent No. D578,424 and Canadian Registration No. 125146).

Acknowledgements

Ève-Julie Arsenault, Tina Rousselle, and Roland Chiasson patiently identified and counted the birds; Alyre Chiasson, Rhéal Savoie, Marie-Josée Maillet, Marcel Léger, Christian Norris, Abel Noel, Sylvio Doiron, and Bettie Arsenault assisted in developing the project; Joe Caissie, Paul Savoie, Martin Mallet, and Serge Leblanc kindly provided access to the study sites. This study was funded by the Professional Shellfish Growers Association of New Brunswick in partnership with the Department of Fisheries and Oceans of Canada (Aquaculture Collaboration Research and Development Program, project MG-06-04-003) and the New Brunswick Department of Agriculture and Aquaculture.

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