Interspecific and Intraspecific Agonistic Behaviour of Gull Species at

Nesting and Non-Nesting Sites

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**Abstract**

**Introduction**

The behaviour of gulls is very dynamic and is influenced by a variety of factors including location and the presence of other species (Hutson 1977, Butler 1981, Butler and Janes-Butler 1982, Dulude et al. 1989, Brown and Morris 1995, Rome and Ellis 2004, Ellis and Good 2006). In particular, agonistic behaviours play an important role in defending territories in nesting birds (Butler and Janes-Butler 1982, Dulude et al. 1989, Ellis and Good 2006). Tinbergen (1953) studied herring and greater black-back gulls and found that agonistic behaviour was more intense between conspecifics than heterospecifics. This may conflict with other studies who have found that more aggressive behaviours were directed towards non-neighbouring conspecific intruders to a territory than neighbouring conspecific intruders (Butler and Janes-Butler 1982); a similar study conducted on ring-billed gulls came to the same conclusions (Dulude et al. 1989). In the former study (Tinbergen 1953), the more familiar individuals were aggressed upon more intensely, whereas in the latter studies (Butler and Janes-Butler 1982, Dulude et al. 1989) the opposite is true.

Just outside Passamaquoddy Bay there is a nesting site for a few species of the family *Laridae* on White Horse Island: the black-legged kittiwakes and the herring and greater black-backed gulls. This area is much more populated than the coastal and island regions in the bay. Coastal areas were defined as locations that are connected to the main land at Brandy Cove, where gulls were found by the shore. We define island locations as any small rock areas that were surrounded by water in and around Passamaquoddy Bay. It has been shown that there are high levels of agonistic behaviour in both nesting locations and feeding locations in gull species (Hutson 1977, Butler 1981, Butler and Janes-Butler 1982, Dulude et al. 1989, Brown and Morris 1995, Rome and Ellis 2004, Ellis and Good 2006). The difference in population sizes at these areas led us to compare the frequency of agonistic behaviours in gulls between locations. Much research has been done on the territorial behaviour of gulls in nesting sites (Hutson 1977, Butler and Janes-Butler 1982, Dulude et al. 1989, Ellis and Good 2006), which suggests that there would be more agonistic behaviour on nesting grounds than other locations. Since gulls are often found with other species, there is the potential for both intra- and interspecific agonistic interactions (Butler and Janes-Butler 1982, Dulude et al. 1989, Rome and Ellis 2004). This led us to compare the frequency of intra- and interspecific agonistic behaviours of gulls seen in Passamaquoddy Bay.

In this study intraspecific behaviour is classified as any agonistic behaviour among any of the three gull species, and interspecific behaviour is classified as any agonistic behaviour between any of the three gull species and any non-gull species. For the purposes of this study, we classified agonistic behaviour as the following behaviours: chasing, physical fighting, oblique-choking, aggressive upright, displacement, and swoop-and-soar (Tinbergen 1959, Butler and Janes-Butler 1982, Dulude et al. 1989, Brown and Morris 1995, Ellis and Good 2006).

We hypothesize that there will be higher instances of interspecific over intraspecific agonistic behaviour. We also hypothesize that there will be more agonistic behaviour in the nesting ground than on coastal or island locations. If our hypothesis is correct, then the gulls on White Horse Island should have the highest frequency of agonistic behaviour. Additionally, the gulls will exhibit more aggressive behaviour toward other bird species over gull species.

**Materials and Methods**

Observations were made using land-based surveys and boat-based surveys on a research vessel (the Fundy Spray) and a whale watching boat (the Quoddy Link) in and around Passamaquoddy Bay, NB. Land-based surveys were used to gather data on coastal groups of gulls in Brandy Cove (St. Andrews, NB; coordinates: 45.084589o, -67.083716o) for 30-60 minutes on July 25th, 26th, 28th, and 29th. Observations made for nesting data on Whitehorse Island (coordinates: 44.992113o,-66.871823o) were conducted for approximately 7-10 minutes on July 23rd, 25th, 26th, and 29th during boat surveys. Counts for gulls were taken during the surveys or after the fact using photographs taken of the sites and extrapolating the number of gulls present. All occurrence sampling using binoculars was used to monitor gulls, and instances of specific agonistic behaviours were documented. The number of agonistic behaviours was estimated from a sample of about one-quarter of the island. To determine the behavioural data of the whole island, we extrapolated the number in one quarter of the island to the whole island. For each location surveyed, the total observation time, number of each species of gull, instances and descriptions of agonistic behaviour and the absence or presence of non-gull species, and the outcome of the agonistic displays was documented. The frequency of the behaviours was calculated by taking the number of agonistic behaviours and dividing by the number of gulls and dividing by the observation time (in minutes).

These behaviours included the swoop-and-soar, oblique-choking, aggressive upright, physical fighting, chasing, and displacement. The swoop-and-soar was when a gull will swoop down over another bird, and then with their wings extended in a V-shape, they steeply ascend until they almost stall (Tinbergen, 1959). Oblique-choking is a combination of displays described by Tinbergen (1959), where the gull takes the oblique posture, spreads its wings completely, and flaps its wings while moving its head forward. The aggressive upright was when a gull positions its beak facing towards the ground with a straight neck; it has been described as an aggressive action (Tinbergen, 1959). Physical fighting could include various behaviours where gulls made physical contact (e.g. pecking). Chasing was when one gull would pursue another bird in flight. Lastly, displacement was defined as when a gull flew towards another gull and forced the other gull to move away. The success of agonistic behaviours were defined as follows: for a swoop-and-soar, the victim would retreat and rest somewhere away from the area they were occupying; for the oblique-choking, the victim would retreat, either flying away from the gull or moving out of its space; the aggressive upright was successful when the victim retreats from the area; physical fighting was successful when the victim retreated from the immediate area; for chasing, the bird being chased would leave the area and not return; and lastly, for displacement, the victim would surrender their spot to the aggressor gull.

Two sample t-test were done using Excel, they were used to determine whether or not there was a difference between frequencies of inter- and intraspecific agonistic behaviour, instances of species-specific agonistic behaviour, and instances of location-specific agonistic behaviour. This test compares the means of the two group behaviours and determines whether or not they are statistically different. An ANOVA test was done in R, that was used to determine whether there was a difference in the frequency of agonistic behaviour between locations and with other species present or absent. The ANOVA test determined whether there was an interaction between the location and presence or absence of other species on the frequency of aggressive behaviours. Lastly, any outliers in the data were determined using Cook’s distance in R.

**Results**

*Intraspecific and interspecific agonistic behaviours*

Figure 1 gives a representation of the average number of agonistic behaviours per observed group within interspecific and intraspecific settings. These results show that the number of interspecific agonistic behaviours is not significantly higher than the number intraspecific agonistic behaviours (p>0.05). Figure 2 illustrates the success rate of interspecific and intraspecific agonistic behaviours in gulls. These results are significant in determining that success rates of the agonistic behaviours are higher in intraspecific interactions (p<0.05). Figure 3 represents the success rates of intraspecific and interspecific agonistic behaviours with one or more aggressors. Interspecific displays with two or more aggressors was significantly more successful than interspecific displays with only on aggressor (p<0.01). Intraspecific agonistic with one aggressor was significantly more successful than interspecific agonistic behaviours with one aggressor (p<0.01). The success of interspecific agonistic behaviour with two or more aggressors was significantly higher than that of intraspecific agonistic behaviour with one aggressor (p<0.05).

*Agonistic behaviours and location*

Figure 4 illustrates the frequency of agonistic behaviour per gull per minute in each of the three locations – White Horse Island, coastal regions, and island regions. The frequency of agonistic behaviours on White Horse Island was significantly higher than those on both the coastal and island regions (p<0.05 and p<0.01 respectively). There was not a significant difference between the frequency of agonistic behaviour between the coastal and island sites p>0.05). A data point for the coastal region was determined to be an outlier using Cook’s Distance, and was not included in the dataset. The ANOVA test (Figure 5) indicated that there was a significant difference in frequency of agonistic behaviour between the locations of White Horse Island and the coastal sites (p<0.01); this statistic corresponds with the previous t-test that we completed. The ANOVA tests also indicated that there is not a significant difference in frequency of behaviours in the absence or presence of non-gull species (p=0.0540). Finally, the ANOVA test indicates that the presence of non-gull species has significantly the same effect at White Horse Island and at the coastal site (p>0.05). Figure 5 shows that the average number of aggressive behaviours per gull for each species is not significantly different among species (p>0.05 for all pairs).

**Discussion**  
*Intraspecific and interspecific agonistic behaviours*  
Unlike some previous studies, where one interaction was favoured (Tinbergen 1953, Dulude et al. 1989), our study showed that there was little difference between the frequencies of these interactions. The results of this study suggest that there is little difference in the number of inter- and intraspecific agonistic behaviours. This did not agree with our hypothesis that interspecific behaviours would occur more frequently than intraspecific behaviours. The lack of significant difference could be due to taking data from a variety of different sites (i.e. nesting and non-nesting). The nature of the sites may dictate the presence or absence of non-gull species: as a nesting site, White Horse Island would attract predators and motivate gulls to be aggressive towards them to protect their nest; gulls may not have the same motivation to protect an area, and predators may not have the motivation to intrude in non-nesting sites such as the coastal and island areas. These factors could lead to less aggressive gulls on the islands and the coast. The contrast of these two situations may lead to a more equal frequency of inter- and intraspecific agonistic behaviours. However, the average number of agonistic behaviours was slightly higher (p>0.05) between interspecific interactions than intraspecific interactions (Figure 1). The slightly increased frequency of interspecific interactions could be due to the difference in frequencies of inter- and intraspecific agonistic behaviours in the coastal habitats (Figure 5).

Unlike the balance seen between frequencies of inter- and intraspecific agonistic behaviours, intraspecific agonistic behaviours were significantly more successful (p<0.05) than interspecific behaviours (Figure 2). This could be due to the fact that most of the interspecific data was from the interactions between gulls and eagles at White Horse Island; the size difference between eagles and gulls may explain why the gulls were not very successful at deterring the eagle from hunting in their nesting ground. This was supported by the higher success rate (p<0.01) of gulls in an aggressive party rather than one individual, where a group would be more intimidating than a lone gull (Figure 3).

*Agonistic behaviours and location*

The rate of agonistic behaviours was significantly higher at White Horse than at the coastal or island habitats (p<0.05 and p<0.01 respectively) (Figure 4). This is in agreement with our hypothesis that these behaviours would occur more at nesting sites rather than non-nesting sites. At first, we thought that the frequency of behaviours would be higher based on the presence of predators; however, Figure 5 and the results of the ANOVA test show a non-significant difference between the frequencies of behaviours with respect to presence and absence of non-gull species. This could indicate that, at a nesting site, agonistic behaviours are always higher than at other locations and that in the presence of a non-gull species, some of the agonistic behaviours are simply redirected to that individual. These results are in agreement with Butler and Janes-Butler (1982) who found that the increased bird population at nesting sites leads to increased frequencies of agonistic interactions. Similar to a point made earlier, coastal and island sites may have lower frequencies of agonistic behaviours because there is more space and resources available for gulls. However, in the presence of a non-gull species on coastal and island habitats, the frequency of agonistic behaviours was higher, though not significantly, than when only gulls were present (Figure 5). This could be because there is little motivation to engage in agonistic behaviour when at a non-nesting site, unless a non-gull species is present.

*Agonistic behaviour in three gull species*

There was no significant difference in the frequency of agonistic behaviour between the three gull species: the greater black-backed gull, herring gull, and the black-legged kittiwake (Figure 6). The frequencies were highest in the black-legged kittiwake, then in the greater black-backed gull, and lastly the herring gull. This agrees with a study that found that there was no significant difference in aggressive behaviours between greater black-backed and herring gulls (Ellis and Good 2006). However, this does not correspond with another study which showed that the greater black-backed gulls usually initiate aggressive interactions with herring gulls (Rome and Ellis 2004). Our data suggests that the greater black-backed gull engaged in agonistic behaviour at a rate more than twice that of herring gulls (Figure 6). Also, our data showed that kittiwakes also performed agonistic behaviours at twice the rate of herring gulls (Figure 6). This could be due to the large number of herring gulls spotted, and fewer observations of kittiwakes.

If agonistic behaviours continue, they may escalate to displace groups of bird populations from important sites (e.g. nesting sites), where they are most common, which could decrease their populations. Equal instances of intra- and interspecific agonistic behaviours, where more intraspecific behaviours are successful may indicate that gulls engage in agonistic behaviour without regard to the consequences; however, further research should be done to investigate the validity of these additional hypotheses.

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**Appendix**

Figure 1. Bar graph of the average number of agonistic behaviours between gulls and interspecific and intraspecific species. The t-test of the data indicates that the number of agonistic behaviours between gulls and interspecific species is not significantly higher than those between gulls and intraspecific species (p>0.05). The error bars represent standard error.

Figure 2. Bar graph of the percentage of success of interspecific and intraspecific agonistic displays in gulls. The t-test indicates that intraspecific agonistic displays have a higher percentage of success than interspecific ones (p<0.05). The error bars represent standard error.

Figure 3. Bar graph of the success of interspecific and intraspecific agonistic displays based on the number of aggressors. The t-test indicates that within interspecific interactions, 2 or more aggressors are significantly more successful than only one aggressor (p<0.01). Another t-test indicates that intraspecific agonistic with one aggressor was significantly more successful than interspecific agonistic behaviours with one aggressor (p<0.01). A t-test indicates that the success of interspecific agonistic behaviour with two or more aggressors was significantly higher than that of intraspecific agonistic behaviour with one aggressor (p<0.05).

Figure 4. Bar graph of the frequency of agonistic behaviours/gull/minute in each of the three types of locations. The frequency of agonistic behaviours on White Horse Island was significantly higher than those on both the coastal and island regions (p<0.05 and p<0.01 respectively). There was not a significant difference between the frequency of agonistic behaviour between the coastal and island sites (p>0.05).

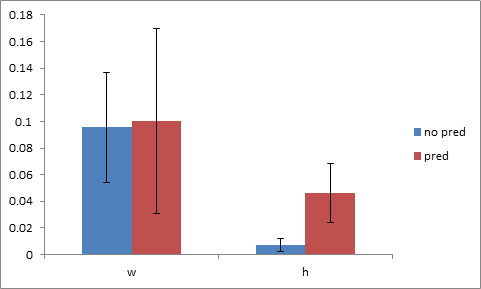


Figure 5. Bar graph representing the differences in frequency of agonistic behaviours at White Horse Island and the coastal sites in the presence and absence of non-gull species.

Figure 6. Bar graph of the frequency of agonistic behaviours per gull for greater black-backed gulls (GBB), herring gulls (HG), and black-legged kittiwake (KW). The t-test between all species indicated that there was not a significant difference in the frequency of behaviour in any of the three species. GBB and HG (p>0.05); GBB and KW (p>0.05); HG and KW (p>0.05).