

**Wintering Harlequin Ducks  
in the Digby Neck – Long Island Area,  
Digby County, Nova Scotia – 2005**

**prepared for**

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**by**

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**20 May 2005**

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## 1.0 INTRODUCTION

There are two major populations of Harlequin Ducks in North America – a relatively large western population and a much smaller eastern population. The eastern population was designated as “Endangered” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in April of 1990 but was downgraded to “Special Concern” in May 2001.

The eastern population is further divided into two sub-populations that are defined by their wintering areas: one in Greenland and the other along the eastern seaboard of North America. The population that winters in Greenland breeds in northern Québec and Labrador. The population that winters along the eastern seaboard of North America breeds in northern New Brunswick, the Gaspé Peninsula, Newfoundland and southern Labrador. It is not known if the breeding grounds of these two populations have some overlap (Sea Duck Joint Venture, Continental Technical Team, 2003; Canadian Wildlife Service Waterfowl Committee, 2002). Preliminary genetic studies appear to confirm reproductive isolation between these two eastern North American populations (Scribner *et al.*, 1999). Of the two eastern populations, the eastern seaboard population is believed to be the smaller with a wintering population currently (pre-2005) estimated at between 1,800 and 2,000 birds (A. Boyne, *pers. comm.*).

Prior to 2005 the estimated numbers of Harlequin Ducks wintering along the coast of Nova Scotia was about 600. There are indications that the numbers of Harlequin Ducks wintering along Nova Scotia’s coast have increased during the past five years (A. Boyne, *in press*).

Wintering Harlequin Ducks have been recorded at several locations along the northern coasts of Digby Neck and Long Island and the coast of Brier Island. The Canadian Wildlife Service (CWS) began annual winter surveys in this area in 2000, conducting land-based surveys in 2000 and 2001 and boat surveys in subsequent years. The highest count prior to 2005 was 86 Harlequin Ducks recorded in 2003, a significant portion (~ 14 %) of the Nova Scotia wintering population.

At only two locations, Bear Cove, Long Island, and the vicinity of Trout Cove, Digby Neck, are wintering Harlequin Ducks found consistently and in good numbers. Harlequins have also been recorded at Sandy Cove and Whale Cove on Digby Neck and at Peajack Cove and Western Light on Brier Island. Only very small numbers of Harlequins have been recorded at these latter sites and these sites are apparently not used consistently.

## **2.0 HARLEQUIN DUCKS AND THE PROPOSED WHITES POINT QUARRY**

As indicated above, winter surveys conducted by CWS since 2000 have established that there are two major wintering areas for Harlequin Ducks in the Digby Neck, Long Island, Brier Island area (Bear Cove on Long Island, Trout Cove area on Digby Neck). These two sites are about 25 km apart with the proposed Whites Point quarry site being almost midway between. Since 2002, the annual CWS boat surveys for Harlequin Ducks conducted in this area included the shoreline of the proposed quarry site. There were no sightings of Harlequins using the shoreline of the proposed quarry site during these surveys. Concern has been expressed that if Harlequins move between the two major wintering areas, there is the potential for this species at risk to be impacted by quarry activities. Whether such movements occur and, if they do, how frequently and what routes are taken (coastal, offshore) are completely unknown. To obtain definitive answers to these questions might require a major study involving radio marking and tracking. This study attempts to obtain some insight into the possible movements of Harlequin Ducks without resorting to intensive and potentially disruptive procedures.

## **3.0 STUDY PLAN**

Observations made by CWS during their annual surveys suggested that:

- 1) there were only two major wintering areas for Harlequin Ducks in the Digby Neck and Islands;
- 2) the wintering area on Long Island was confined to Bear Cove;
- 3) the wintering area on Digby Neck consisted of three adjacent coves: First Cove, Trout Cove and Shingle Cove;
- 4) there was only infrequent use by small numbers of Harlequin Ducks of select coastal waters between these two major wintering sites.

If the above model was correct and if the populations at each of the major wintering sites could be kept under simultaneous surveillance, then, if movements occurred between these two sites, a major exodus from one site would be followed by a similar increase in the population at the other site.

Surveillance of the two sites for two or three consecutive days could confirm whether the underlying premises of the model are correct and, if so, establish whether there are short-term movements of Harlequins between the two sites. Should the underlying assumptions of the model hold true and no short-term movements of Harlequins were detected, then additional surveillance of the two sites at about one week and two to three weeks after the initial surveillance should indicate whether there might be longer term movements between sites.

If frequent movements between the sites were suspected, then one or two days of observations at the Whites Point property might verify if these movements occurred along the coastline of the property.

The annual boat survey conducted by CWS could serve as an independent check, using a different methodology, on the numbers of Harlequins as determined by our studies as well as providing information on the possible presence of birds outside the areas under surveillance.

All observations should be conducted in the January or February period when migrational movements of Harlequins would not be expected. For results to be credible, observations should be taken only when sea state and visibility conditions are as close to optimal as possible.

#### 4.0 **STUDY AREAS**

During this investigation, studies were carried out at three separate locations. For the purposes of this report, these locations will be referred to as the “Bear Cove study area”, which included both Bear Cove and Little Bear Cove; the “Trout Cove study area”, which included First Cove, Trout Cove and Shingle Cove; and the “Whites Point property”, which is the parcel of land owned by Bilcon of Nova Scotia Corporation where the proposed quarry site is to be established. The relative locations of these study areas are shown in Figure 1. Aerial photographs of these three study areas are shown in Figures 2, 3 and 4, respectively. All three study areas have rocky (basalt) shorelines.

##### 4.1 **Bear Cove Study Area**

Bear Cove is relatively isolated although it is accessible by a woods road that is navigable by off-road vehicles. There is one small cabin in Little Bear Cove that is in poor repair and appears to be abandoned. There are no buildings in Bear Cove although there is a cottage to the southwest of the cove. Except for a small rock outcrop at the southwest extremity of the cove and a larger outcrop near the centre of the cove, the shoreline is gentle tide-worn rock. The southern half of Little Bear Cove is also “gentle” tide-worn rock; however, the northern half of the cove shoreline is rock outcrops and boulders. About 1.8 km of the shoreline of these two coves was under surveillance.

##### 4.2 **Trout Cove Study Area**

The south of Trout Cove is dominated by a breakwater, wharves and associated buildings. The road to the wharf is lined with houses. A gravel road extends from Trout Cove to the lobster plant near the northeast extremity of Shingle Cove. An

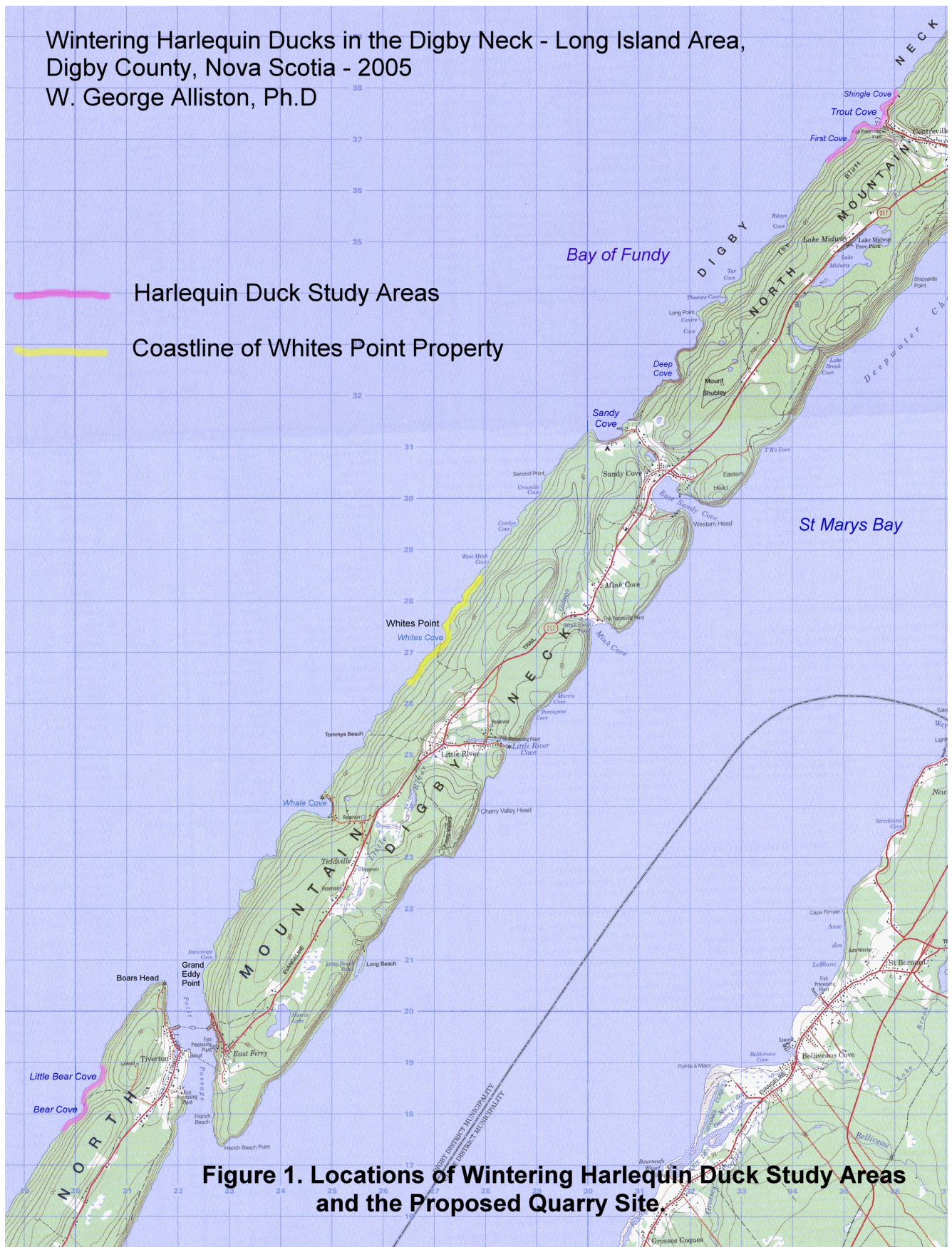
ATV trail runs parallel to the coast from Trout Cove to First Cove. The headlands at Trout Cove are rock outcrops rising perhaps 5 to 10 m above the high tide mark. Shingle Cove and most of the First Cove shoreline is low surf-worn basalt with some rock outcrops at the southwestern extremity of First Cove. About 2.2 km of shoreline in this area was under surveillance.

#### 4.3 Whites Point Property

The Whites Point property has been described elsewhere (Alliston, 2004). It extends for 2.8 km along the Bay of Fundy shoreline (see Figure 4). The coastline to the southwest of Whites Cove consists of small (< 10 m) coastal cliffs, rock outcrops and large boulders. To the northeast of Whites Cove, the coast line is much more gentle. A road that is passable by off-road vehicles links Whites Cove to Highway 217. An ATV trail runs along the coastline northeast of Whites Cove. There are currently no buildings on this property. A 4-ha area surrounding an old mine site at Whites Cove was cleared in 2002 and, in preparation for quarrying, a settling pond was subsequently constructed. There are no buildings on the property and no quarrying activities had been conducted at the time of this study.



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**A** -- observation post

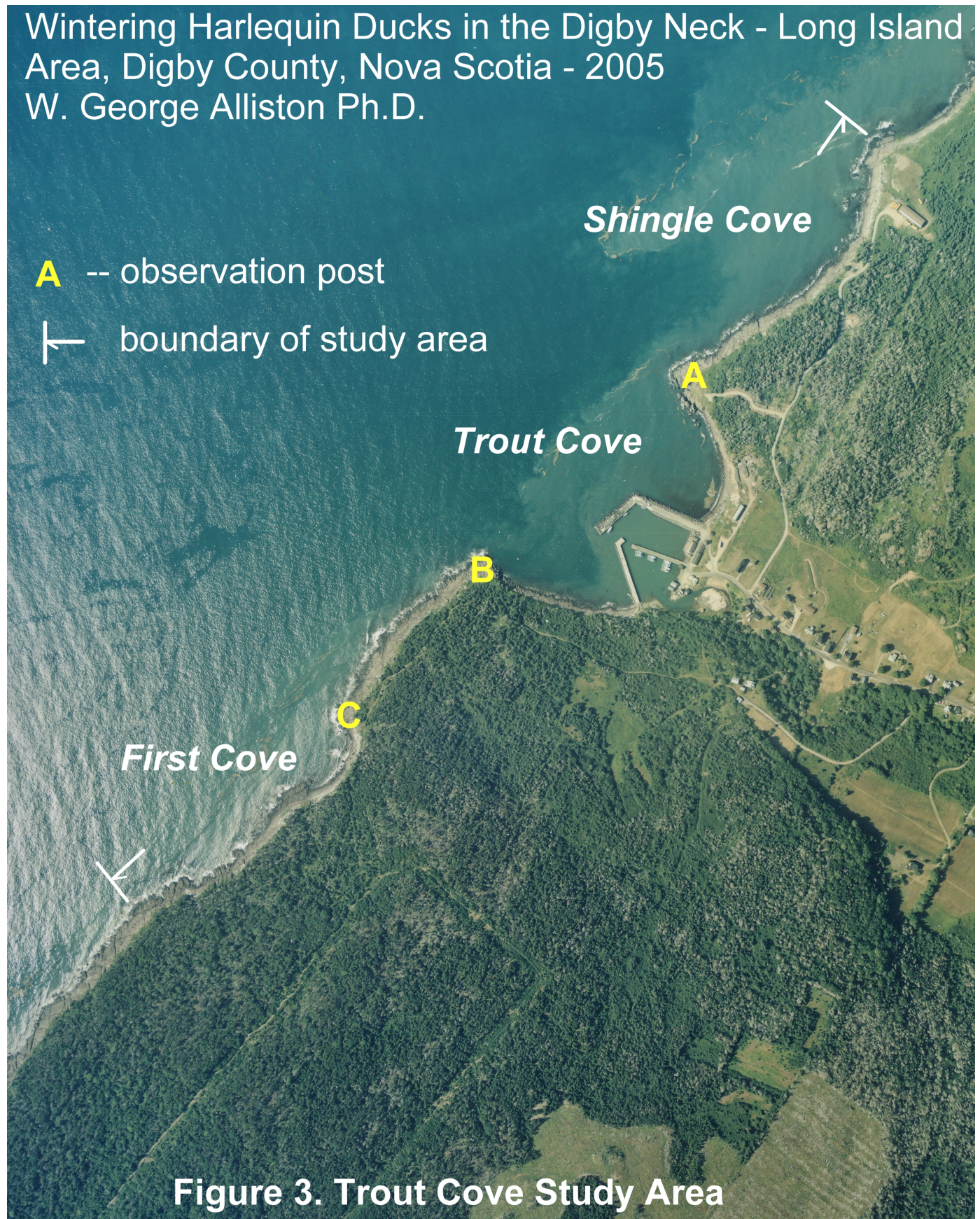
└ boundary of study area



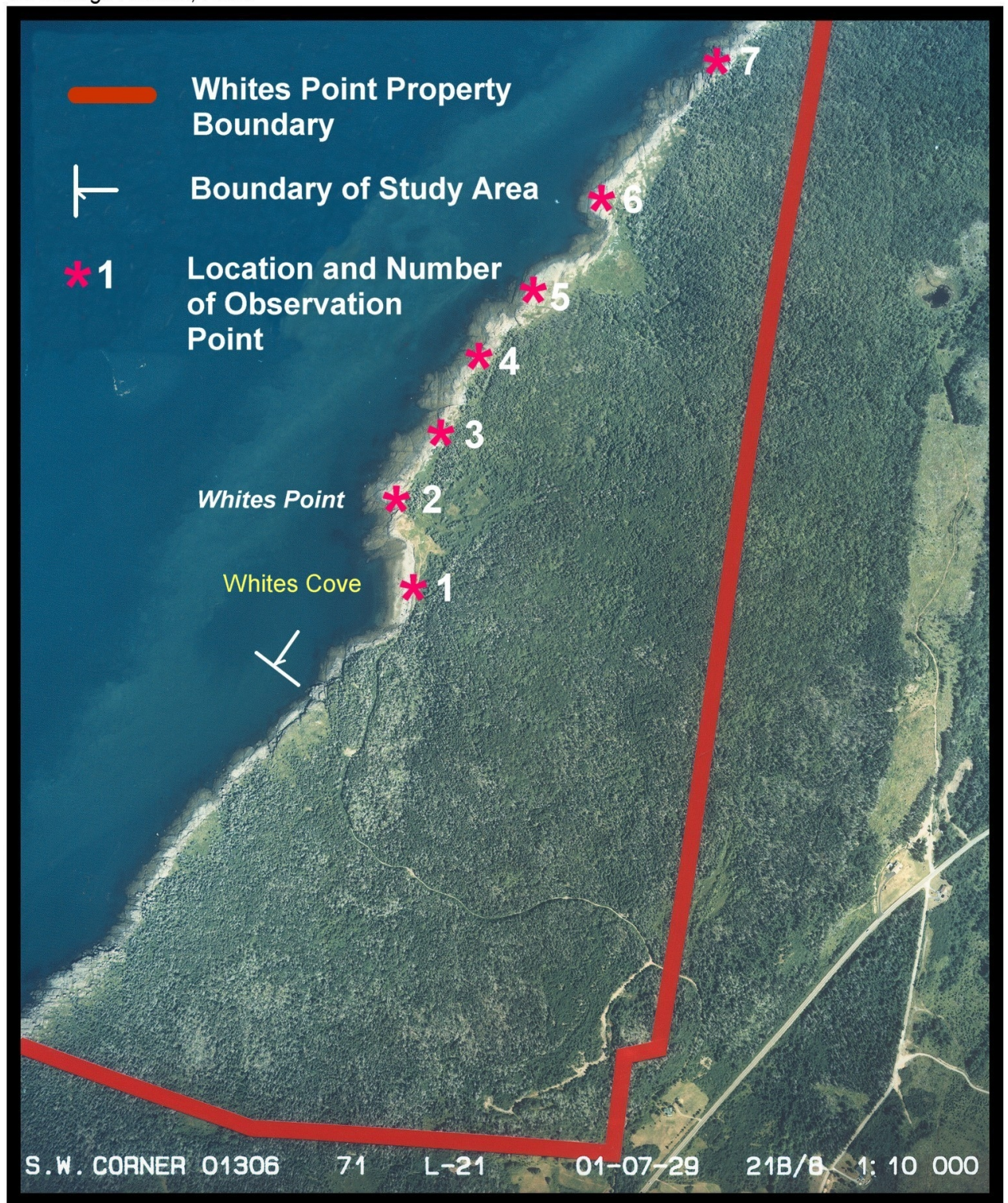
**Figure 2. Bear Cove Study Area**



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Figure 4. Area under observation and observation points used during Harlequin Duck monitoring at Whites Point property, 7 February, 2005.



## 5.0 **BEAR COVE AND TROUT COVE MONITORING**

### 5.1 Methods

It was the intent of this study to keep all Harlequin Ducks in the two study areas under more or less continuous surveillance. If continuous surveillance was not possible, then a complete count of all Harlequin flocks using the study areas was to be attempted at half-hour intervals on the hour and half hour.

On 16 January 2005, Mr. Bernard Forsythe and I visited the Bear Cove and Trout Cove study areas to plan the logistics of the population monitoring study. It was determined that one observer could adequately cover the Bear Cove study area. An observer stationed at observation point A (Figure 2) could see both Bear Cove and Little Bear Cove. Although observation point A was the primary site from which surveillance of the study area was to be conducted, observation points B, C and D could be accessed on occasions when a closer approach was needed to observe Harlequin flocks. For safety reasons (snow- and ice-covered rock outcrops and boulders), travel to the northeast of observation point D in Little Bear Cove was not possible.

Logistical considerations at the Trout Cove study area required two observers to adequately monitor Harlequin populations. An observer stationed at observation point A (Figure 3) could survey all of Shingle Cove and all but the southeast corner of Trout Cove. From observation point C a second observer could survey all of First Cove and a portion of the shoreline between First Cove and Trout Cove. This observer would also have to “commute” regularly to observation point B to assure coverage of all of the shoreline between the southwest tip of Trout Cove and First Cove and the southeast corner of Trout Cove.

Blinds were not used and the observers made no attempt to conceal themselves. Each observer was equipped with binoculars (10x) and a telescope (20x, 20→45x zoom, 38x). The two observers in the Trout Cove study area were equipped with two-way radios and one had a 35 mm camera with a 210 mm telephoto lens to obtain photographic records should large (hence difficult to count) flocks of Harlequins be encountered.

Each observer was provided with copies of aerial photographs on which to plot the locations of flocks under observation. General notes on the behaviours of the flocks were also taken (e.g. feeding, resting, hauled out, alert, flushed, etc.).

In addition to counting the flocks and the numbers of birds within each flock, the numbers of males and females (sex ratio) were to be determined and, if possible, the ages of the birds (first-year vs. adult). A close examination of plumages will show

differences between first-year and adult birds; however, the differences are subtle, particularly with females.

## 5.2 Results

### 5.2.1 Preliminary Observations

On 16 January 2005, under overcast skies, and with calm winds and seas and very good visibility, Bernard Forsythe and I visited the two study areas to evaluate the logistics of conducting a surveillance of Harlequin Ducks in these areas. During our morning visit to Trout Cove and Shingle Cove, flocks of 19 (10 males, 9 females) and three (2 males, 1 female) Harlequins were recorded, respectively. In the afternoon we visited First Cove and recorded a flock of seven Harlequins there.

In late morning we visited Bear Cove and Little Bear Cove. A flock of 33 Harlequins was observed in Bear Cove but none was seen in Little Bear Cove.

In the afternoon we visited Whale Cove and Sandy Cove, locations where small numbers of Harlequins had been reported previously. No Harlequins were observed at either of these sites.

### 5.2.2 Personnel and Timing

Surveillance of the Trout Cove and Bear Cove study areas was conducted on 1 February 2005 and 2 February 2005. Observations were conducted at the Trout Cove study area between approximately 0800 h and 1700 h and at the Bear Cove study area between approximately 0900 h and 1600 h on each day.

Mr. Bernard Forsythe, a well respected naturalist and amateur ornithologist, conducted the surveillance of the Bear Cove study area. The author and Dr. Larry Bogan conducted the surveillance of the Trout Cove study area. I covered Shingle Cove and the northern portion of Trout Cove and Dr. Bogan covered First Cove and the southern portion of Trout Cove. While Dr. Bogan's Ph.D. is in physics, he is an avid naturalist, a founding and honorary life member of the Blomidon Naturalists Society and currently Vice-President of the Federation of Nova Scotia Naturalists.

### 5.2.3 Weather

The weather was cold on both mornings of the survey (between -15°C and -20°C) but warmed through the day to just a few degrees below zero. Both days were sunny and in the early morning there was a light breeze off the land; the breeze soon subsided. Other than the light land breeze in the early morning, winds were calm on 1 February as was the sea state. Visibility was excellent. The morning of 2 February began the

same as 1 February; however, by late morning a breeze had developed from the northeast and persisted until late afternoon. Although by the afternoon of 2 February the seas were no longer calm, they were not sufficiently rough to significantly impair visibility.

#### 5.2.4 Human Activity

In the Digby Neck, Long Island, Brier Island area, the lobster fishing season extends from late November to the end of May. The buoys of lobster traps were liberally scattered throughout the inshore waters along this coastline. On 1 February 2005 lobster boats were attending their traps in both study areas. In addition, on three occasions between 1146 h and 1415 h, a fishing boat either entered or exited the harbour at Trout Cove. On 2 February 2005 there was no boat activity adjacent to Bear Cove and only a single boat passed by Trout Cove.

Land-based human activities at the Bear Cove study area during the two days of observations were confined to those of the observer. In the Trout Cove study area, other than the loading and unloading of the fishing boats at the wharf in Trout Cove on 1 February, there was relatively little human activity. The road between Trout Cove and the lobster plant in Shingle Cove was used by a few vehicles (including ATV's) each day. There was no land-based human activity in the First Cove area other than that of the observer.

#### 5.2.5 Harlequin Ducks

##### 5.2.5.1 Behaviour

Harlequin Ducks on their wintering grounds tend to form tight flocks. When feeding they tend to dive almost synchronously, followed by a somewhat less synchronous return to the surface, followed by a brief “pause” period when they recover from their dive (during which social interactions also occur), followed by another dive. Goudie (1999) recorded mean dive times of  $21.7 \pm 7.4$  (SD) seconds and a mean pause time of  $12.0 \pm 6.3$  (SD) seconds ( $n=368$ ) for Harlequins wintering in the Queen Charlotte Islands. Goudie (1999) also found that the Harlequins he was observing in February spent just over 60 % of daylight hours feeding. In Maine, Goudie and Ankney (1986) recorded mean dive durations of  $25.7 \pm 0.3$  (SE) seconds ( $n=513$ ) and pause durations of  $15.6 \pm 0.3$  (SE) seconds ( $n=513$ ). Goudie and Ankney (1986) also found that the average proportion of the time spent feeding was 68.9 % and this increased in cold weather and in the evening. This study did not attempt to quantify the behaviours of Harlequin Ducks and while the dive times and pause periods are probably similar to those observed by Goudie (1999) and Goudie and Ankney (1986), the portion of the period over which the birds were observed that was spent feeding was much higher in our study areas: probably exceeding 90 %. This might be a reflection of the relatively cold conditions under which the observations were made.

In addition to their major activity, feeding, Harlequins were observed to take some brief rest periods when birds would preen, flap their wings and, in some cases, haul out on the rocky shoreline or rocks protruding from the water. These infrequent rest periods were brief, generally lasting for no more than one or two minutes. On only two occasions was an entire flock observed to haul out; these lasted for less than one minute. The longest rest period recorded during this study lasted for nine minutes. We made no observations of Harlequin Ducks sleeping.

When a perceived threat was encountered the Harlequins would cease feeding and become very attentive with heads erect and swim away from the source. Threats that elicited this response included the close approach of a boat, human presence on adjacent land and gulls landing amongst a feeding flock. Overall the Harlequins were not particularly skittish and few incidences of this behaviour were observed.

Harlequin flocks flushed in response to fishing boats entering or leaving Trout Cove and, on one occasion only, to a boat attending traps. In the former case, both American Black Ducks and Common Eiders in the area flushed before Harlequins. The three entries and exits of fishing boats at Trout Cove over a 2.5-hour period on 1 February displaced all (24) Harlequin Ducks from this cove and they had not returned by the time observations ceased at about 1700 h, even though boat activity had ended at 1415 h. In the only case where a flock was observed to have been flushed by a lobster boat attending traps, the Harlequins flew about 200 m, landed and immediately resumed feeding. A similar reaction was observed when a small plane flew over at about 700 m. On one occasion a pair of Common Ravens circling over a flock of Harlequins appeared to elicit flushing of the flock; however, we are not certain that the Ravens were the causal agent.

On one occasion a lone courting pair of Harlequin Ducks was observed to attempt copulation.

#### 5.2.5.2 Use of Study Areas

As indicated above, Harlequin Ducks were involved in feeding activities for almost the entire time they were being observed in the two study areas. During our two days of observations, Harlequin Ducks fed in areas adjacent to the entire shorelines of both study areas. Feeding flocks were generally active within 50 m of shoreline. However, on the afternoon of 2 February, a flock of 40 Harlequins spent almost two hours feeding in waters estimated to be 100 m to 200 m from the shoreline of Shingle Cove. When feeding, flocks tended to move slowly on a course parallel to shoreline. It did appear, however, that Harlequins spent a disproportionate amount of time feeding off the “headlands” of the coves.

#### 5.2.5.3 Use of Areas Adjacent to Study Areas

It was observed that Harlequin Ducks also used areas immediately to the southwest and northeast of the two study areas. On four occasions feeding flocks were recorded to have “disappeared” into areas beyond the study area. In three cases, what were believed to be the same feeding flocks (similar numbers) later reappeared from whence they had gone. Absences from view were a maximum of 1.5 hours so it is unlikely that these feeding birds had moved large distances beyond the study area.

At Bear Cove flocks of Harlequins were observed flying into the study area from both the northeast and southwest. On one occasion when the observer was stationed at the southwestern extremity of Bear Cove, a flock of four Harlequins flew into Bear Cove from the northeast, past a feeding flock of Harlequins, and continued flying to the southwest until they could no longer be seen. In the Trout Cove study area, only a pair of Harlequins was observed flying into the study area from the southwest and no birds were observed flying in from the northeast. However, two observations were made of flocks flying from the study area to the northeast. Both of these observations were made late in the afternoon (1640 h and 1701 h) so these birds may have been moving to a roosting area. At night Harlequin Ducks roost in open water farther from shore (> 1 km) (Fleischner, 1983 *in* Robertson and Goudie, 1999).

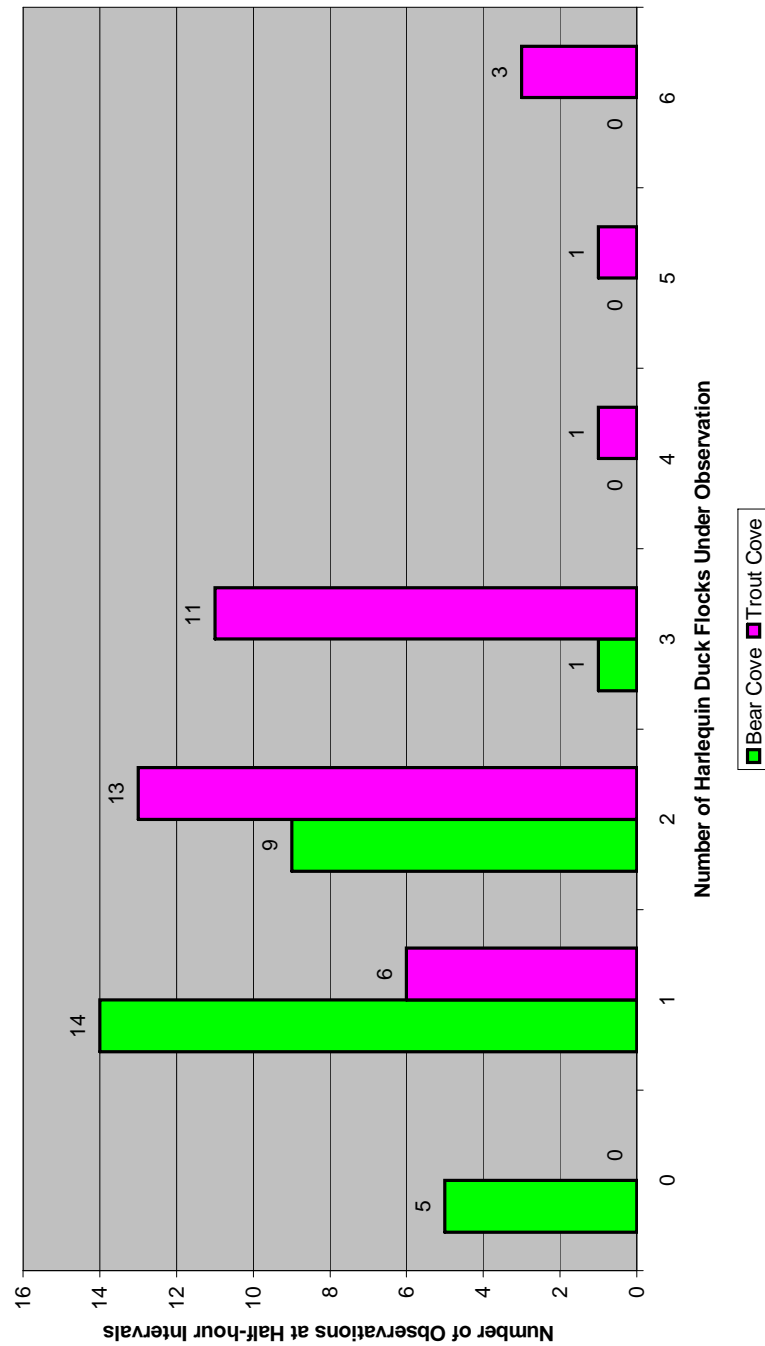
#### 5.2.5.4 Flocks

A “sampling” of the number and size of feeding Harlequin Duck flocks under surveillance was obtained at half-hour intervals (on the hour and half hour) in each of the study areas for the duration of our two days of observations.

##### 5.2.5.4.1 Flock Numbers

The frequency with which a given number of flocks was being observed simultaneously in each of the study areas is presented in Figure 5. The number of flocks under surveillance at the Bear Cove study area varied from none (in five “samples”) to three (in one sample) (n=29). At the Trout Cove study area there was no time when no Harlequin Duck flocks were under surveillance. The number of flocks under surveillance varied from one (in six “samples”) to six (in three “samples”) (n=35). The mean and median numbers of flocks under observation were 1.2 and 1 respectively in the Bear Cove study area while at the Trout Cove study area these numbers were 2.6 and 2 respectively.

Figure 5: Number of Harlequin Duck flocks under observation at half-hour intervals  
in the Bear Cove and Trout Cove study areas, Digby County, Nova Scotia  
1 February 2005 and 2 February 2005



#### 5.2.5.4.2 Flock Size

The tight flocks of almost constantly feeding birds, their high activity levels and the short “pause” period when the entire flock was at the surface made counting and sexing of flocks of more than 25 birds rather challenging. However, multiple counts of each flock and, in the case of one large flock, a series of photographs, made estimation of flock size necessary on only five occasions.

The frequency with which flocks of various sizes were “sampled” in each of the study areas is presented in Figure 6. The range in flock size observed in the two study areas is identical with minimum size being two birds (always pairs) to a maximum of 44 birds. Similarities end there. The mean flock size observed at the Trout Cove study area (10.9) was almost half that recorded at the Bear Cove study area (19.4). A better metric for comparison would be the median flock size which was 8 in the Trout Cove study area and 22 in the Bear Cove study area.

#### 5.2.5.4.3 Discussion

While the range of flock sizes observed in both study areas was identical, flock size was considerably greater in the Bear Cove area while the number of (smaller) flocks under observation in the Trout Cove study area was considerably greater than in the Bear Cove study area. The reasons for these apparent differences are not at all clear. Although Harlequins using the Trout Cove study area are subjected to more human activity, during the period of observation this level of activity was not high and on only one occasion was observed to lead to a major rearrangement of the flocks present. This rearrangement actually led to a consolidation of flocks. I can only speculate that these apparent differences may relate to differences in the distribution of food resources in the two areas.

#### 5.2.5.5 Populations Using the Study Areas

The total numbers of Harlequin Ducks under observation in each of the study areas is presented in Figure 7 (1 February) and Figure 8 (2 February).

During the first day of observations (1 February) the numbers of Harlequin Ducks in the Trout Cove study area showed some variation in the early morning but, by 1100 h, had stabilized and remained more or less constant (varying between 21 and 24 birds) for the remainder of the day. In the Bear Cove study area, the numbers of Harlequins under surveillance were fairly stable (varying between 22 and 26 birds) between 1000 h and 1345 h at which time the numbers doubled to 51. By 1500 h most of the Harlequins under surveillance in the Bear Cove study area were in a large flock off the northeast headland of Little Bear Cove and some birds were moving out of sight beyond the headland. Because of large flock size and difficulties in viewing the



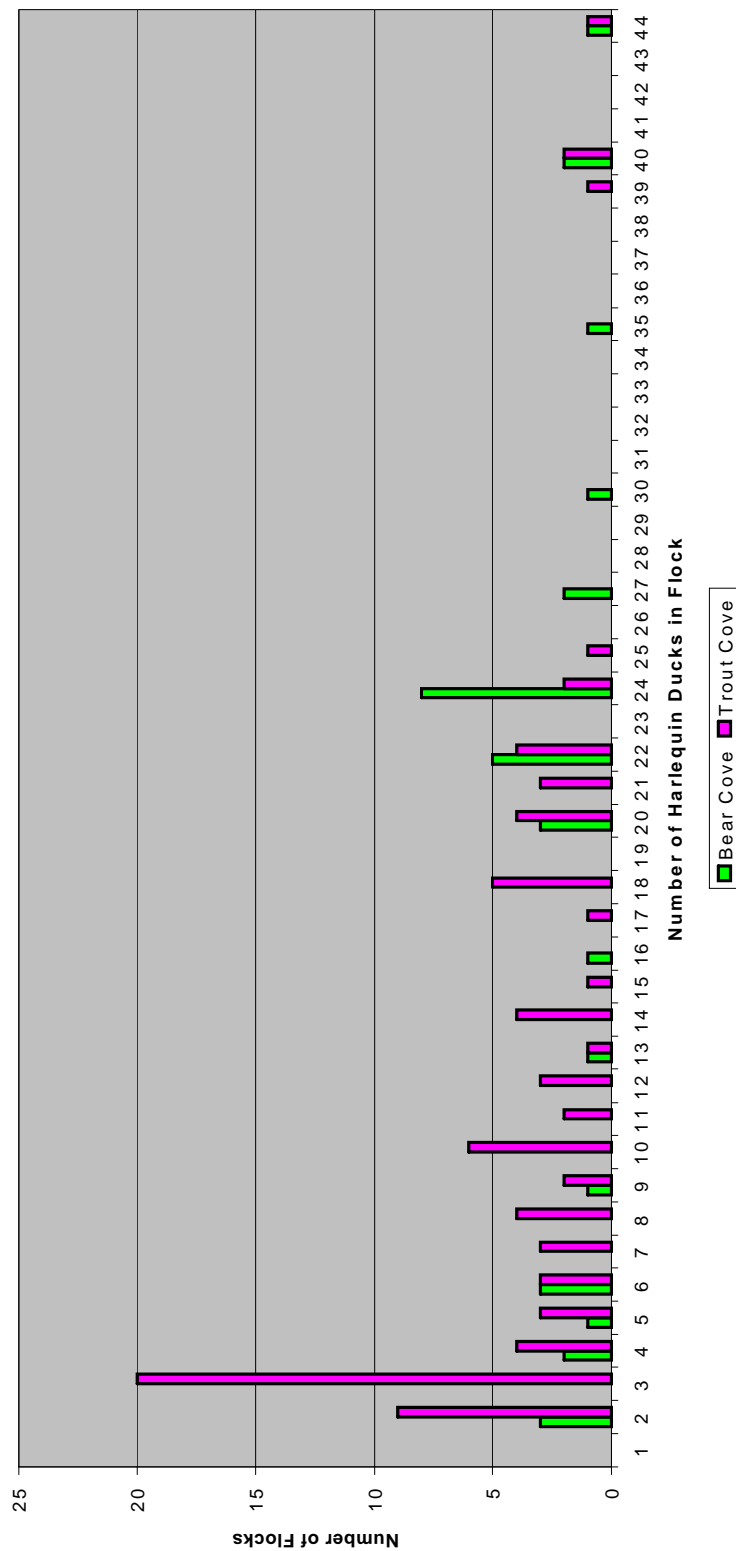
birds in the area of the headland, the numbers recorded after 1415 h include estimates (vs. counts) of flock size.

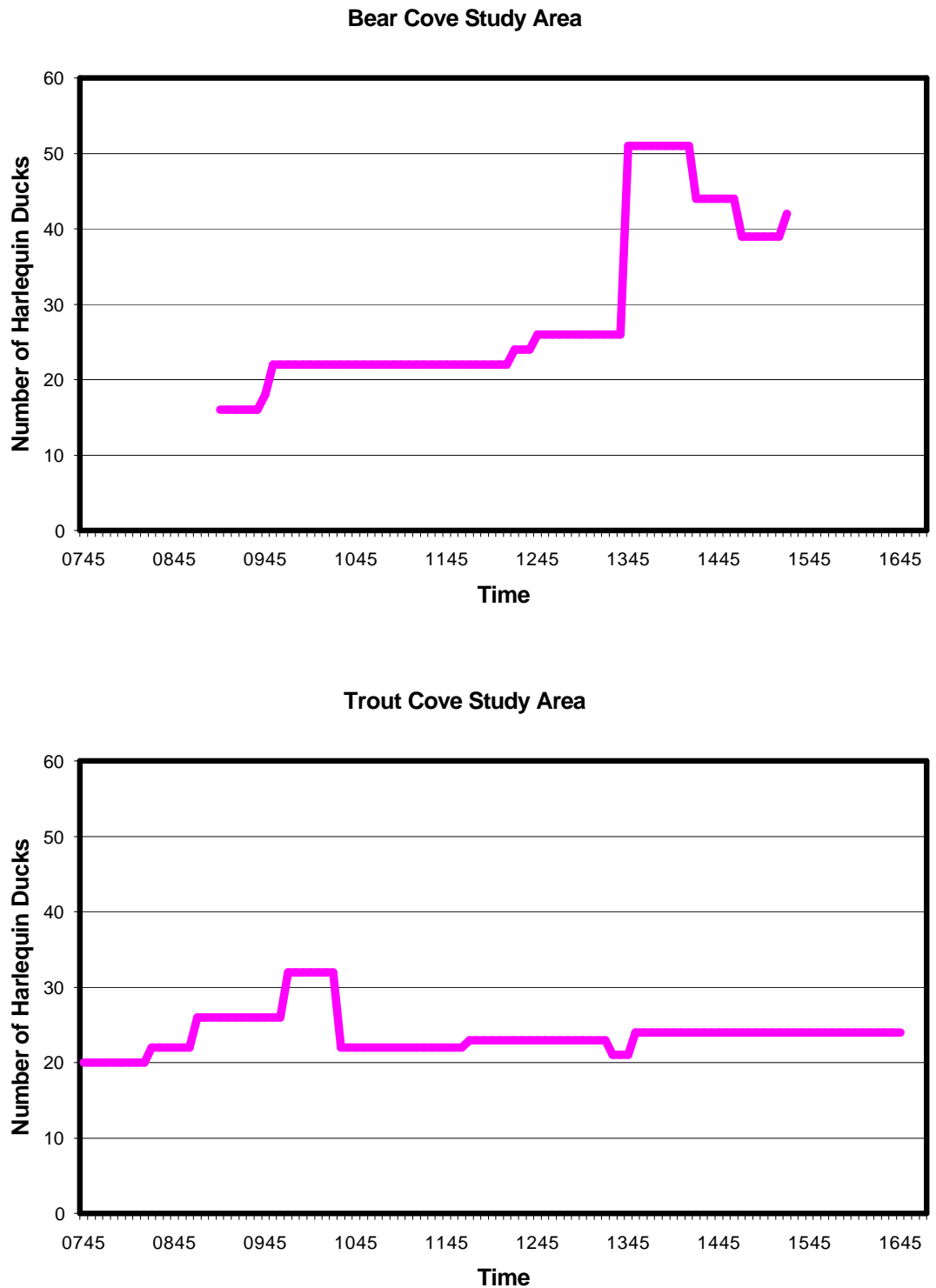
During the second day of observations (2 February) in the Trout Cove study area, Harlequin numbers built from the low 20's at 0830 h to about 30 by noon. There was a drop in numbers at noon when a flock of 12 birds swam beyond the southwest limits of the study area; however, a flock of 11 birds flew into the study area at 1335 h bringing the population under surveillance to the low 30's (32). At 1420 h a large flock had flown into the study area more than doubling the total number of birds under surveillance (67). At 1640 h this large flock (now numbering 40 birds) flushed from near the northeastern extremity of the study area and flew out of the study area toward the northeast.

The second day of observations (2 February) at the Bear Cove study area produced some very erratic results (Figure 8). During that day most Harlequins under surveillance were using Little Bear Cove, particularly the northeastern half of the cove. On two occasions, between 1130 h and 1440 h, all flocks that had been feeding in Little Bear Cove continued feeding while moving past the northeast headland of the cove and out of sight of the observer. The flocks reappeared briefly at about 1245 h but soon disappeared beyond the headland and were not observed again until 1440 h. By 1530 h they had reached numbers (~ 44) similar to those recorded in the morning (40).

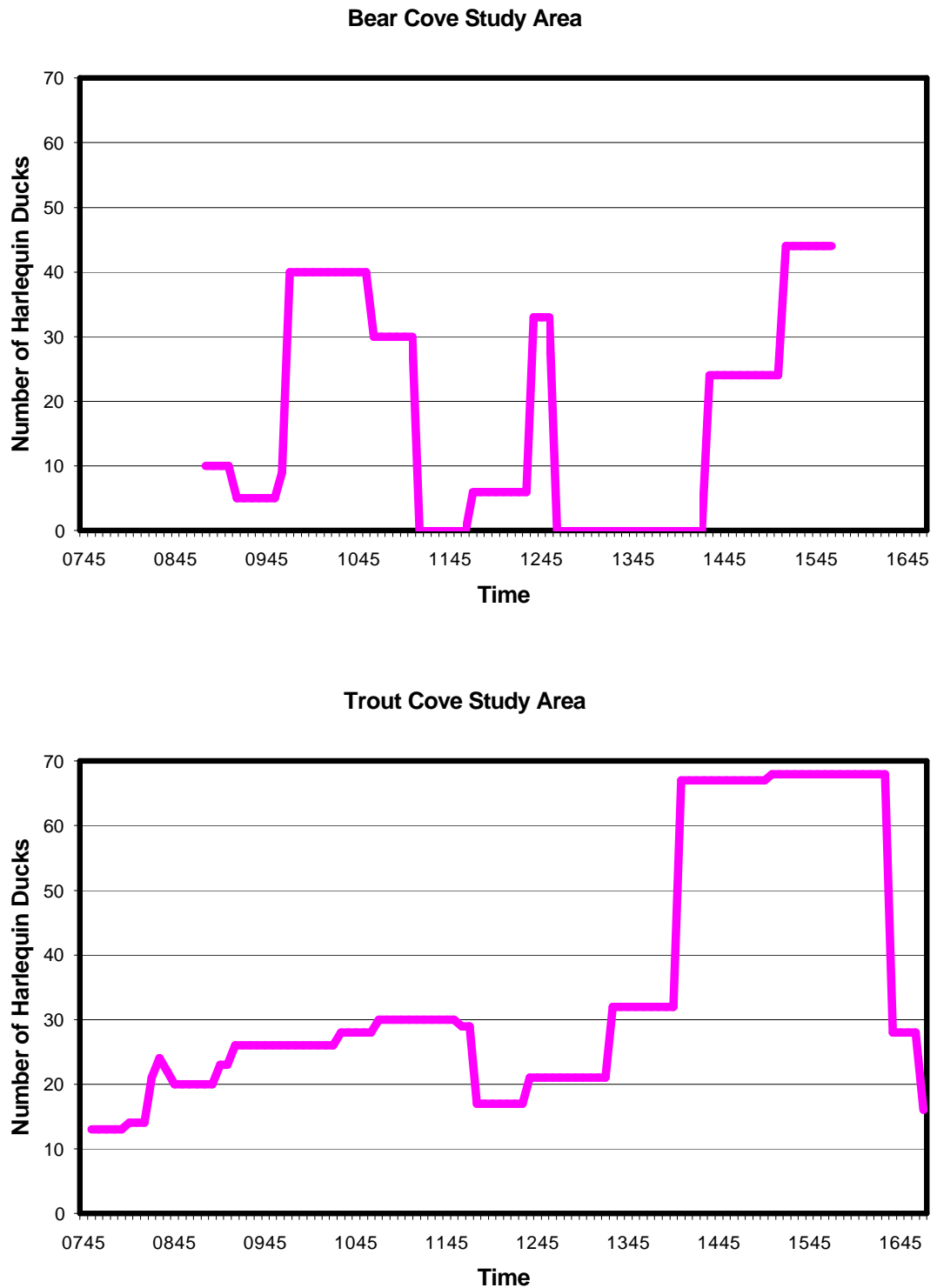
The maximum numbers of Harlequin Ducks counted at the Trout Cove study area on 1 February was 32 and on 2 February was 68. The maximum numbers seen in the Bear Cove study area was 51 on 1 February and 44 on 2 February. The maximum numbers of birds observed simultaneously in both study areas occurred on the afternoon of 2 February when there were 44 birds under observation in the Bear Cove study area and 68 in the Trout Cove study area for a total of 112 Harlequin Ducks.

Figure 6: Size of Harlequin Duck flocks under observation at half-hour intervals  
in the Bear Cove and Trout Cove study areas, Digby County, Nova Scotia  
1 February 2005 and 2 February 2005





**Figure 7. Number of Harlequin Ducks under observation in the Bear Cove and Trout Cove study areas: 1 February 2005.**



**Figure 8. Number of Harlequin Ducks under observation in the Bear Cove and Trout Cove study areas: 2 February 2005.**

#### 5.2.5.5.1 Sex Ratios

The sex ratios of Harlequin Ducks using the two study areas at the time maximum numbers were observed in each area is presented in Table 1.

<b>Table 1 Sex Ratios of Harlequin Ducks at Time of Maximum Count</b>					
<b>Study Area</b>	<b>Date</b>	<b>Max. Count</b>	<b>Males</b>	<b>Females</b>	<b>Male/Female Ratio</b>
Bear Cove	1 Feb	51	31	20	1.55:1
Trout Cove	2 Feb	68	30	38	0.79:1
<b>Total</b>		119	61	58	1.05:1

In the Bear Cove study area, sex ratios were heavily weighted toward males while in the Trout Cove study area there was a distinct weighting toward females. The totals for the two study areas suggest a balanced sex ratio.

#### 5.2.5.5.2 Age Composition

No quantitative data was collected concerning the age composition of the Harlequin Duck populations using the two study areas. Differences between the plumages of first-year and adult males can be determined when examined at close range; however, the differences between first-year and adult females are quite subtle. Close approach was often not possible from our observation sites. For the flocks that could be examined closely we identified no first-year birds.

### 5.3 Discussion

The main reason for conducting this study was to obtain an indication of whether there were frequent and significant movements of Harlequin Ducks between their two known major wintering areas in the Digby Neck and Islands. If such movements were to occur and our efforts at monitoring populations at the two sites were successful, then a major influx of birds into one site would be accompanied by a similar decrease in birds at the other site with the total population of the two areas remaining constant.

Major influxes of Harlequins into the Bear Cove study area occurred on the afternoon of 1 February when the population under surveillance doubled (Figure 7) and into the Trout Cove study area on the afternoon of 2 February when the population more than doubled (Figure 8). It is clear from Figures 7 and 8 that neither of these influxes was accompanied by a similar decrease in the numbers of Harlequins at the other site. Indeed, on the days that major influxes were recorded at one study area, the populations under surveillance at the other study area remained relatively constant (see above). We must therefore conclude that the source or sources of the major influxes of birds witnessed in both study areas lie outside the two study areas.

During the study it became quite evident that the study areas did not encompass the entire area being used by Harlequin Ducks at each of these sites; Harlequins were observed to use adjacent areas to the northeast and southwest of each of these study areas. It would seem most likely that the influxes of Harlequins witnessed in each of the study areas originated from the areas immediately adjacent to the study areas that this study revealed were used by Harlequins, but were not under surveillance. However, this portion of the study cannot rule out the possibility that these birds originated from parts of the other site that were not under surveillance.

Recognizing that the study areas did not, as hoped, cover the entire area used by Harlequins at either of these sites, the data collected for the purpose of estimating populations using these two areas are likely to be biased (low), the degree being dependent upon how great a portion of the areas used by Harlequins the study areas encompassed and the amount of movement of these birds within the sites. We observed that feeding flocks did not generally stay at a single location for extended periods of time but tended to move slowly along the shorelines as they fed and, infrequently, to fly to different portions of the study area.

Estimates of Harlequin Duck populations using the two sites can be derived from our data using two different assumptions: that no movement occurred between the sites during the study or that movement may have occurred between the two sites. If no movement occurred between the sites, then the best estimates of the Harlequin populations using these sites would be the maximum numbers observed at each site during the two days of observation i.e. 51 birds in the Bear Cove study area on 1 February and 68 birds in the Trout Cove study area on 2 February for a total of

119 birds using the two sites. If, however, there were frequent movements of Harlequins between these two sites, then the best estimate of the total size of Harlequin Duck populations using the two sites would be the maximum numbers of birds observed simultaneously at both sites which was 112 birds: 68 birds in the Trout Cove study area and 44 in the Bear Cove study area on the afternoon of 2 February. These two estimates are not substantially different (~ 6 %).

## 6.0 **WHITES POINT PROPERTY MONITORING**

Observations were made at the Whites Point property to determine if Harlequin Ducks were:

- 1) using the inshore waters adjacent to the property as a travel route between their two major wintering areas in this region and/or
- 2) using the shoreline of this property for feeding.

### 6.1 **Methods**

To detect what could well be just a single flock of Harlequin Ducks flying past the Whites Point property over the course of a day would require both good viewing conditions and constant vigilance. So that the latter was achieved, two observers were used to assure that at all times at least one was searching the coastal waters for flying flocks of Harlequins. To simultaneously achieve our second objective, surveying the shoreline for the possible presence of feeding Harlequin Ducks, searches were conducted from a series of observation points along the shoreline of the property. While one observer was en route to a “new” observation point, the second observer remained at the “old” observation point maintaining a seaward watch for flying flocks of Harlequin Ducks. When one observer was established at the “new” observation point then this observer would assume the seaward watch for flocks of flying Harlequins while the second observer would make his way to the “new” observation point. Both observers would remain at the “new” observation point with one watching for flying flocks while the other searched the shoreline and coastal waters for feeding flocks of Harlequins as well as other waterbird species. This process was continued until all the shoreline that was safe to survey was completed. The two observers then returned, in the same manner, to Whites Point where both conducted continuous monitoring for flying flocks of waterbirds.

Both observers were equipped with binoculars (10x) and spotting scopes (Bushnell 20x and Bushnell 20 to 45x zoom). All observations were recorded on a digital voice recorder. Records of all observation points were taken with a GPS (Garmin GPS76).

## 6.2 Results

### 6.2.1 Personnel and Timing

Bernard Forsythe and I conducted the survey on 7 February 2005 between 0810 h and 1705 h.

### 6.2.2 Weather

The temperature in the morning was about  $-7^{\circ}\text{C}$  rising to the freezing point during the day. The day was sunny and winds and sea were calm. In fact, the sea was so calm that the sky was reflected in it giving a mirror-like appearance against which swimming and flying birds were highly observable. Viewing conditions could not have been better.

### 6.2.3 Human Activity

The coastal waters adjacent to the Whites Point property contained many lobster traps. When we arrived at Whites Point at 0810 h there were three fishing boats pulling lobster traps along the coastline of the property to the southwest of Whites Cove. These boats worked their way in a northeasterly direction along the coast of the property throughout the morning hours and, indeed, fishing boats were continuously present (generally two or three) in these coastal waters until 1630 h.

### 6.2.4 Harlequin Ducks

The observation points from which we searched the shoreline for feeding and/or flying flocks of Harlequin Ducks are shown in Figure 4. The time from our arrival at Whites Cove at 0810 h to 1223 h was spent working our way from observation point to observation point to near the northeastern boundary of the property. We returned to the Whites Point observation point (# 2) at 1321 h and spent the remainder of the afternoon observing from that location. Since the shoreline of the property to the south of Whites Cove consisted of cliffs, rock outcrops and boulders that were snow- and ice-covered, safe travel in this area was not possible. A portion of this shoreline could be viewed using spotting scopes from the Whites Point observation site. However, coverage of this portion of the property was incomplete.

There were many waterbirds using the coastal waters of the Whites Point property on the day of our survey (see Alliston, 2005); however, no Harlequin Ducks were observed either feeding along the shoreline or flying past.



### 6.3 Discussion

Lobster boats were actively hauling traps in the waters adjacent to the Whites Cove property during most of the time observations were being made on 7 February. Their activities resulted in major movements of sea ducks using this area during the time our survey for Harlequin Ducks using the coastal waters between Whites Cove and the northeast boundary of the property was being conducted (0810 h to 1223 h); however, it was only during the last hour (after 1121 h) that boats were close enough to the observers to cause waterfowl adjacent to the observers to flush. Harlequins generally use the shallow waters immediately adjacent to the shoreline and are further from the lobster boats than other sea ducks that tend to use deeper waters for foraging. Our observations at the Trout Cove and Bear Cove study areas indicated little reaction by Harlequins to lobster boats hauling traps (see above). It was also clear from the CWS boat surveys that Harlequins were less inclined to flush than other sea ducks upon the close approach of a fishing boat. I therefore believe that lobster boat activity adjacent to the Whites Cove property was not a factor that influenced our lack of observation of Harlequin Ducks using the coastal waters adjacent to the property. Our observations are consistent with the results of the winter boat surveys conducted by CWS which, to date, have not revealed any use of the coastline of the Whites Cove property by Harlequin Ducks.

While we did not observe any Harlequin Ducks flying along the coastline of the Whites Point property, and our observations were conducted under ideal weather and sea state conditions, this task is a difficult one with a real risk of failure. Firstly, the opportunity to detect a flock flying past the observers and within range of vision would be short, probably not more than a minute. Our observations at Bear Cove and Trout Cove indicated only one major influx (a single flock) into either of these areas each day. So, if our observations at Bear Cove and Trout Cove were representative, then, if movements between these two areas were occurring, we could expect to have only one flock per day fly past. Secondly, there was considerable “background noise” during our observation period. This “noise” consisted of the fairly large numbers of waterbirds present in the area and the activity of lobster boats which resulted in the flushing of many waterbirds, mainly waterfowl. Since all flying waterbirds had to be identified (at least as not being Harlequins) then if, as all did, they turned out not to be Harlequins, the time spent identifying these birds was time diverted from our main task. The presence of two observers helped this situation somewhat.

Thus, while the lack of observation of Harlequin Ducks flying past the Whites Point property along its inshore waters is consistent with the view of Harlequin movements that we have derived from these studies, these data are perhaps the least compelling of those collected.

## 7.0 CANADIAN WILDLIFE SERVICE BOAT SURVEY

Since 2002, the CWS has conducted annual winter surveys for Harlequin Ducks using the Bay of Fundy shoreline in the Digby Neck – Long Island area. These surveys have been conducted from a boat which, for Harlequin Ducks, is considerably more effective than the standard aerial surveys used to census most waterfowl species (see Alliston, 2005).

### 7.1 Methods

As in previous years the 2005 Harlequin Duck survey of the Digby Neck – Long Island area was conducted from a Cape Islander lobster boat which proceeded at speeds of from 12 to 18 km/hr parallel to and within about 150 m of shoreline. When Harlequin Ducks were observed, if a closer approach was required to count, sex and age the flock, then the boat was slowed and the Harlequins cautiously approached. When approached, Harlequins cease their activities (feeding, resting) and assume an alert pose. Although it is easier to obtain the required statistics from an “alert” flock than from a feeding flock, “alert” flocks can remain compact making larger flocks still quite difficult to count. If obtaining the required metrics from an alert flock proves excessively difficult, then a still closer approach will cause the flock to flush. The flying birds are more easily counted. However, the flushed flock may break up, head off in different directions and/or join other flocks thereby making extraction of the required metrics challenging. Flushing the flock is generally a method of last resort.

All observers were equipped with binoculars. One observer also had a gunstock-mounted 20x Bushnell telescope. Tracks of the survey route were taken using a GPS (Garmin GPS76). All observations were recorded by the author on a digital voice recorder with time stamping so that observations could readily be associated with GPS positions.

Prior to the CWS boat survey I advised Andrew Boyne, the CWS Wildlife Biologist in charge of the Harlequin Duck surveys, that during our land-based studies we had learned that Harlequin Ducks were using areas adjacent to, but outside, our study areas at Bear Cove and Trout Cove and beyond the extremities of the area normally covered by the boat survey. However, it was agreed that the population estimates obtained from our land-based work would not be shared until the boat survey had been completed.

## 7.2 Study Area

The southwestern and northeastern boundaries of the 34 km of coastline that was surveyed by boat in 2005 are shown in Figure 9. In 2005, each of the boundaries was extended about 2.3 km beyond the boundary of the 2004 survey. In 2004 the boundaries were the southwestern tip of Bear Cove and the northeastern tip of Shingle Cove.

## 7.3 Results

### 7.3.1 Personnel and Timing

The annual CWS Harlequin Duck survey was conducted on 9 February 2005. Andrew Boyne and Julia McKnight of CWS conducted the survey and were accompanied by the author and Bernard Forsythe. The same boat, the “Georgie Porgie”, and skipper, Tim Crocker, had participated in this survey since the boat surveys began in 2002. We sailed out of Tiverton and first surveyed the coastal waters of Digby Neck starting at Grand Eddy Point at 0903 h and finishing at Little Deep Cove at 1150 h. We then deadheaded back to Petite Passage where we began the survey of the Long Island shoreline at Boar’s Head at 1310 h and completed this survey at 1352 h.

### 7.3.2 Weather

9 February 2005 was a clear day with calm winds and seas and temperatures a few degrees below the freezing point. Survey conditions could not have been better.

### 7.3.3 Human Activity

We encountered no other boats using the coastal waters during our survey.

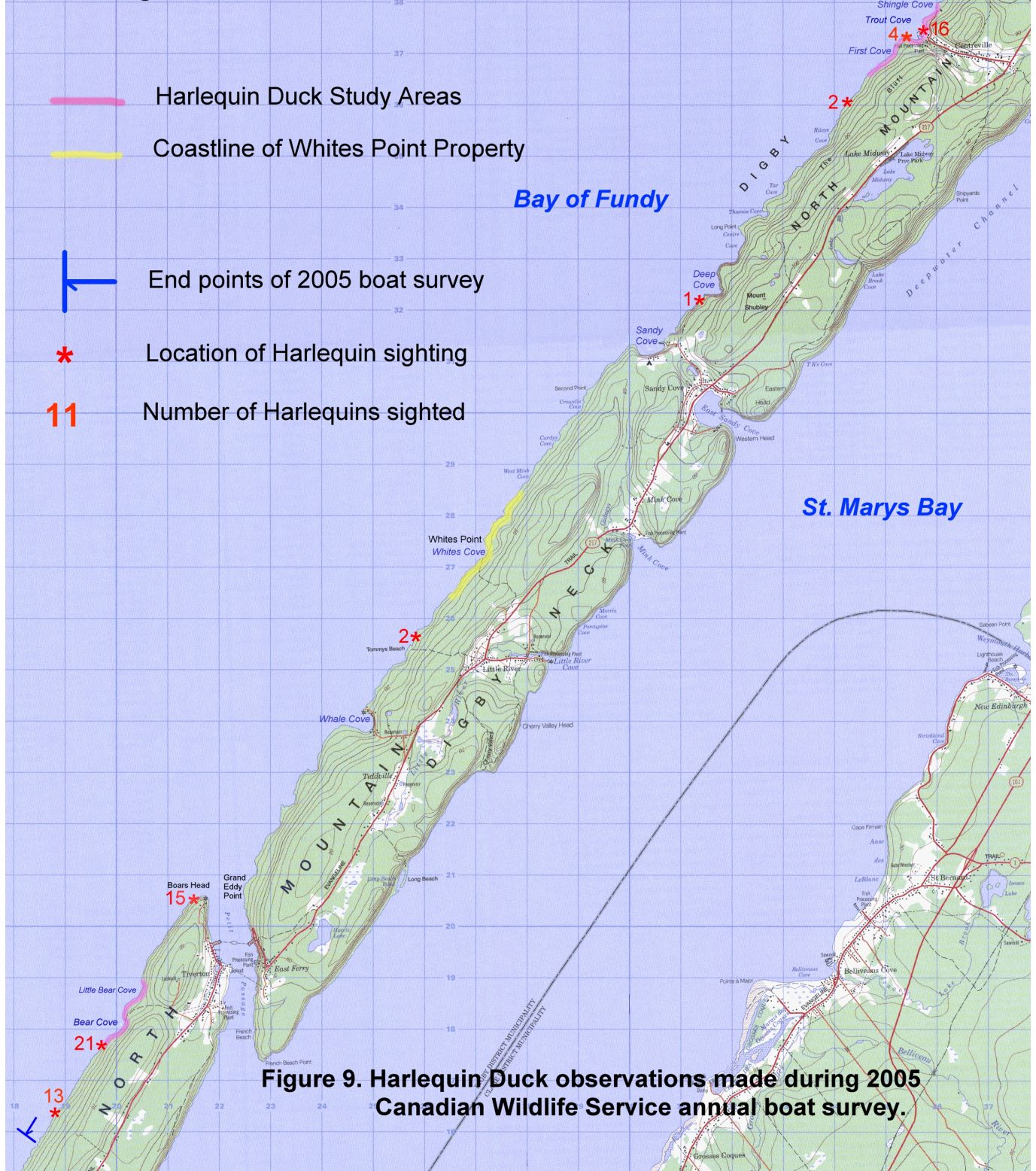
### 7.3.4 Harlequin Ducks

#### 7.3.4.1 Numbers and Distribution

A total of 118 Harlequin Ducks was counted on the boat survey on 9 February 2005. The locations and numbers of birds observed are presented in Figure 9. Although Harlequins were concentrated around the Bear Cove and Trout Cove study areas, significant numbers were observed in areas immediately adjacent to but outside the study areas. At Bear Cove, 15 birds were observed 1.9 km to the northeast and another 13 birds 1.8 km to the southwest of the study area. At Trout Cove a pair of Harlequins was observed 0.8 km to the southwest and a flock of 44 birds 1.0 km to the northeast of the study area.



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**Figure 9. Harlequin Duck observations made during 2005  
Canadian Wildlife Service annual boat survey.**



Outside these two areas only three Harlequin Ducks were found. A pair of Harlequins was observed hauled out on the shore about 1 km southwest of the southwest boundary of the Whites Point property. Three hours and twenty minutes after they were first observed (when we were deadheading back to Petite Passage), this pair was still in the same location. A single female was observed near the southwest point of Deep Cove.

#### 7.3.4.2 Sex Ratios

The numbers of Harlequin males, females and birds whose sex was not determined during the boat survey are presented in Table 2.

<b>Table 2 Sex Ratios of Harlequin Ducks Observed During Boat Survey</b>				
	<b>Males</b>	<b>Females</b>	<b>Undetermined</b>	<b>Sex Ratio M:F</b>
Bear Cove Area	23	21	5	1.10:1
Trout Cove Area	20	24	22	0.83:1

These data suggest a slight bias toward males in the Bear Cove area and a somewhat more pronounced bias toward females in the Trout Cove area.

#### 7.3.4.3 Age Composition

Again, no quantitative data was collected on the age composition of the Harlequin Ducks. However, it was noted that for those birds that were seen at close range no first year birds were identified.

### 7.4 Discussion

The 118 Harlequin Ducks recorded in the 2005 boat survey was the highest population level recorded since CWS initiated its annual surveys of this area in 2000, eclipsing the 2004 count of 67 birds. The highest previous count was in 2003 when a total of 86 Harlequins was observed. The highest previous count for the Bear Cove area was 48 Harlequins in 2004 (49 in 2005) and, for the Trout Cove area, 40 birds in 1999 (66 in 2005) (A. Boyne, *pers. comm.*). (Note: The 1999 observation was made during an oil spill investigation prior to the initiation of annual surveys.)

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Whether the apparent dramatic increase in the total population between 2004 and 2005 is real cannot be determined with certainty. An additional 4.6 km of coastline (2.3 km at each extremity) was surveyed in 2005 and, although this amounts to an increase of only 16 %, within these new areas 57 Harlequin Ducks were counted (48 % of total count). In addition, the sea state (Beaufort 4) at the time of the 2004 survey was far less favourable for making observations.

Boyne (*in press*) has, however, noted an apparent upward trend in total populations of Harlequins wintering in Nova Scotia over the period that annual surveys have been conducted. Indeed, the results of the 2005 winter surveys conducted by CWS indicate a wintering population closer to 1,100 Harlequins (A. Boyne, *pers. comm.*) – up sharply from previous estimates of about 600 birds (A. Boyne, *in press*). If, as it seems, this upward trend applies to the populations wintering in the Digby Neck area, then it is likely that increasing populations of Harlequins - birds that exhibit a very high degree of faithfulness to traditional wintering areas (Robertson and Cooke, 1999; Robertson *et al.*, 1999) - would extend their use into areas immediately adjacent to their traditional wintering areas should suitable habitat exist in these areas.

The 2005 boat survey also confirmed what the land-based survey had indicated: that Harlequins in the two major wintering sites were not restricting their activities to the study areas where we had previously believed they were confined. At Trout Cove, the area being used extended at least 1 km on either side of the study area and, at Bear Cove, at least 2 km on either side. The numbers of Harlequins observed in these areas were sufficient to account for the influxes of birds into each of the study areas observed during the land-based study.

## 8.0 DISCUSSION

A comparison of estimates of Harlequin Duck populations derived from boat and land-based studies is presented in Table 3.

<b>Table 3 Comparison of Harlequin Duck Population Estimates: boat survey and land-based survey</b>				
<b>Survey Method</b>	<b>Trout Cove</b>	<b>Bear Cove</b>	<b>Other</b>	<b>Total</b>
Boat	66	49	3	118
Land-based				
a) Maximum counts <sup>1</sup>	68	51	-	119
b) Maximum simultaneous count <sup>2</sup>	68	44	-	112
<sup>1</sup> Best population estimator assuming no or infrequent travel between sites.				
<sup>2</sup> Best population estimator if there is frequent travel between sites.				

The agreement between these independent estimates is quite remarkable: particularly between the boat survey and the land-based survey that assumes no movement between the two major wintering areas. The similarity in estimates was achieved even though a basic premise of the original design, that the entire wintering grounds at both sites fell within the study areas, proved to be incorrect. The fact that these independent estimates were made one week apart strongly suggests that there was little or no movement of Harlequin Ducks between the two sites during that period.

It is possible, although highly unlikely, that while the total numbers of Harlequins remained the same at the two sites over the study period, there may have been an “equal exchange” of birds between sites. It was noted in our land-based survey that sex ratios differed quite markedly between the two study areas. If a substantial “exchange” occurred between the sites, unless the “exchange” consisted only of groups having the same sex ratio, then a difference in sex ratios might be detectable between the two surveys. A comparison of sex ratios obtained from the land- and boat-based surveys is presented in Table 4.

Table 4 Comparison of Harlequin Duck Sex Ratios: boat survey and land-based survey														
	Bear Cove					Trout Cove					Total			
	M	F	U	M/F Ratio		M	F	U	M/F Ratio		M	F	U	M/F Ratio
Land Survey	31	20	0	1.55:1		30	38	0	0.79:1		61	58	0	1.05:1
Boat Survey	23	21	5	1.10:1		20	24	22	0.83:1		43	45	27	0.96:1
M = Male				F = Female				U = Undetermined						

Both data sets indicate unequal sex ratios at the two sites with females being more prevalent at the Trout Cove site and males being more prevalent at the Bear Cove site. At the Trout Cove site the results for the two surveys were nearly identical with 0.79:1 being the M:F ratio derived from the land-based survey and 0.83:1 the ratio derived from the boat survey. Sixty-seven percent of the Harlequins observed at the Trout Cove site during the boat survey were sexed. At the Bear Cove site, where 90 % of the Harlequins counted during the boat survey were sexed, the sex ratio was 1.10:1, notably lower than that recorded from the land-based survey (1.55:1). Given that both the sex ratios and total numbers of Harlequins at the Trout Cove site appeared to remain constant, and there are no other known sources of Harlequins in this area, I would interpret the apparent differences in sex ratio at the Bear Cove site to be due to sampling error. This would infer that, while the boat and land-based population estimates are very similar, both may be low and the actual population of Harlequins using the Bear Cove site is somewhat larger than our estimates would indicate.

The very fact that, in February, these two sites support populations which together have a sex ratio that is near 1:1 but, individually, have unequal sex ratios, in itself would suggest that there is little movement of Harlequins between these two sites. Harlequins arrive on their wintering grounds in autumn. Pairing occurs on the wintering grounds and commences with their arrival. Robertson *et al.* (1998) found that, in his western study population, 60 to 80 % of female Harlequins were paired by mid-December and by March almost 100 % of females were paired. Young birds were the last to form pairs. Our impression was that there were few first-year birds in the populations using the Digby Neck area in 2005. (Andrew Boyne (*pers. comm.*) found a general lack of first-year birds in all wintering areas surveyed in Nova Scotia in 2005.) If the pairing regime of eastern populations of Harlequins is similar to that of western populations then, by the time our study was conducted, pair formation should have been nearly complete, particularly so if our impressions about the lack of first-year birds in the population were correct.



Harlequins are known for their fidelity to wintering areas (Robertson and Cooke, 1999). This is particularly true for females. Females have been shown to prefer particular locations within locally favourable habitat. Males exhibit a greater tendency to move amongst sites looking for mates; however, once paired, males tend to stay with their mates (Breault and Savard, 1999; Robertson *et al.*, 1999). It is likely that, if movements between the Bear Cove and Trout Cove sites were to occur, then males searching for and taking mates would tend to equalize the sex ratios at the two sites given that the combined sex ratios at the two sites are essentially 1:1. That nearly equal sex ratios had not been achieved at these two sites by early February suggests that movements between these two sites may be minimal even over longer time periods.

## 9.0 CONCLUSIONS

- 1) Boat surveys conducted by CWS since 2002 and our own on-site survey in 2005 indicated no use of the coast of the Whites Point property by wintering Harlequin Ducks.
- 2) The closest observation of wintering Harlequin Ducks to the Whites Point property was recorded during the CWS boat survey in 2005 when a single pair was observed approximately 1 km to the southwest of the property.
- 3) Although our information was obtained by indirect methods and was not extensive, all information obtained by three separate approaches indicated that there was little or no movement of Harlequin Ducks between the Bear Cove and Trout Cove wintering areas during the study period (1 February 2005 to 9 February 2005). Furthermore, dissimilar sex ratios in the populations using the two study areas suggests that, even over longer periods of time, movement of Harlequins between the two wintering sites may be limited. With limited movements of Harlequins between the two wintering areas, there would be limited opportunities for these birds to interact with quarry operations.

## 10.0 ACKNOWLEDGEMENTS

I would especially like to thank Andrew Boyne, Wildlife Biologist - Species at Risk, Canadian Wildlife Service, for his generosity in sharing insights and information regarding Harlequin Ducks and allowing Bernard Forsythe and I to accompany him on his 2004 and 2005 winter boat surveys of the Digby Neck – Long Island area.

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#### 11.2 Personal Communications

Boyne, Andrew, Wildlife Biologist - Species at Risk, Canadian Wildlife Service,  
Endangered Species and Protected Areas Section, Dartmouth, Nova Scotia.

#### 11.3 Websites

Atlantic Canada Conservation Data Centre – <http://www.accdc.com>

Committee of the Status of Endangered Wildlife in Canada – <http://www.cosewic.ca>

Environment Canada - <http://www.speciesatrisk.gc.ca/>

Environment Canada - <http://www.on.ec.gc.ca/wildlife/wildspace/>

Nature Serve – <http://www.natureserve.org>

Nova Scotia Department of Natural Resources - <http://www.gov.ns.ca/natr/wildlife/>