



# Fly Monitoring Program Final Report 2010

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## Introduction

Fly complaints, issued by residents of communities surrounding mink farms across Newfoundland and Labrador, were first documented in the fall of 2004 and carried through 2005 and 2006. The complaints were made about mink ranches across the province, as well as other small fly breeding sites such as hobby farms, fish plants, local dump sites, etc. Throughout the province, there are on-going residential, tourism, and commercial development and expansion in the vicinity of expanding mink ranches. This has caused land use conflicts between these ranches and the residents and business owners of these areas.

Past research concentrating on fly species associated with animal facilities, such as poultry, has proven that several sampling techniques can be used in monitoring populations of flies. Such sampling techniques are baited jug traps, sticky ribbons and spot cards (Lysyk and Axtell, 1986).

Baited jug traps are plastic jugs with entry holes in the top and a commercial fly bait of a given amount placed in the bottom. They are hung with wires throughout the livestock facility or outside on stakes. These traps monitor the fly species that are attracted to the bait and show the increases and decreases in the fly populations, if monitored.

Sticky ribbons are fly tapes that hang throughout the facility. They are collected and counted weekly and are useful in monitoring the species present and the fly activity in an area.

The fly spot card method is based on 3" x 5" index cards placed inside livestock facilities in locations where flies are known to congregate as well as places that can be used for an overall representation of the barn. The flies leave behind spots composed of excreta and vomit. The spots are counted on a weekly basis and can be used as an index of fly abundance and activity.

The comparison of sticky ribbons and spot card indexes in conjunction with nuisance complaint times can aid in the establishment of a threshold that can be used to determine timing and selection of pest management techniques.

There have been several fly species observed on and around fur farms including, but not limited to, common house flies, *Musca domestica* L.; the lesser housefly, *Fannia canicularis* L.; blow flies, *Calliphora* species; and green bottle flies, *Phacenia* species. However, it has been observed that it is the lesser housefly that is in the highest population during the fly season prompting the majority of nuisance complaints.

The literature reviewed concludes that the lesser housefly *F. canicularis* is not attracted to the regular baits that work for other fly species. For this reason, sticky ribbons and spot cards will be the two main sampling methods within the sheds (Lysyk, 2006).

The objectives of this project were:

1. To determine the fly species present on mink farms in the area and to determine the time of year that the populations spike;
2. To determine whether the spot card method of assessing fly abundance and activity, used in poultry facilities, can be adapted to mink ranching; and
3. To determine thresholds that can be established from the card numbers that reflects complaint response.

## Materials & Methods

The research protocols followed in this project were developed by Dr. Tim Lysyk, research scientist, Livestock Insect Population Ecology, with Agriculture and Agri-food Canada.

Three locations were set up throughout the island, namely Farm 1, Farm 2 and Farm 3. Each location consisted of on-farm and off-farm monitoring areas, which had both spot cards and sticky ribbons as representative samples. The farms' monitoring specifics were based on the initial data analysis after 2007. Dr. Lysyk stated that spot card and sticky ribbon numbers were correlated at all farms, therefore either could be used as an index of fly activity. The size of the sheds was described as either being small or large. The small shed had only two aisles and measured approximately 100 ft long by 20 ft wide. The large shed had three aisles and measured approximately 200 ft long by 40 ft wide. The number of aisles and size of sheds determined the amount of spot cards and sticky ribbons that were needed.

### 1.0 Farm 1:

#### 1.1 On-Farm

Five spot cards per aisle were placed in every second shed. Four sticky ribbons were placed in the sampled sheds, with one ribbon placed in each corner. The cards and ribbons were collected and replaced on a weekly basis.

#### 1.2 Off-Farm

There were no off-farm monitoring sites set up for this location.

### 2.0 Farm 2:

#### 2.1 On-Farm

Five spot cards per aisle were placed in every second shed. Four ribbons were placed in the sampled sheds, with one ribbon placed in each corner. The cards and ribbons were collected and replaced on a weekly basis.

#### 2.2 Off-Farm

Off-farm sites were established for Farm 2. The sites were collected and reset on a weekly basis.

### 3.0 Farm 3:

#### 3.1 On-Farm

Five spot cards per aisle were placed in every second shed. The 2008 season saw a reduction in sticky ribbon numbers throughout the sheds. Only four ribbons were placed in the

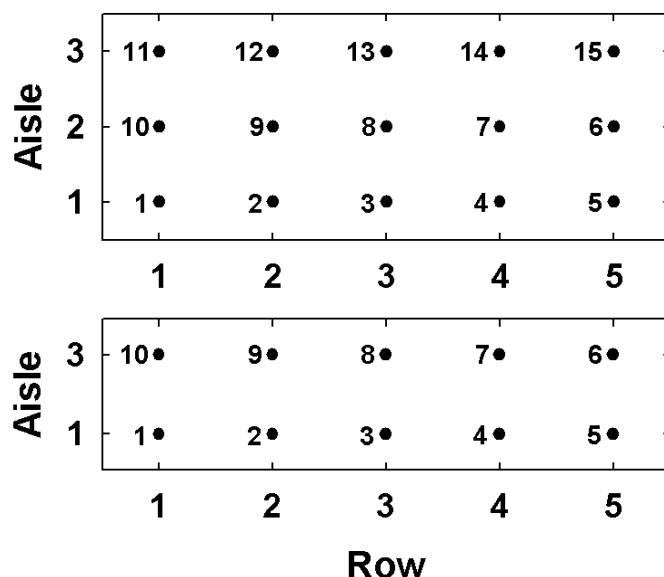
sampled sheds, with one ribbon placed in each corner. The cards and ribbons were collected and replaced on a weekly basis.

### 3.2 Off-Farm

Off-farm sites were established for Farm 3. Spot cards and sticky ribbons were placed out, and the samples were collected and reset on a weekly basis.

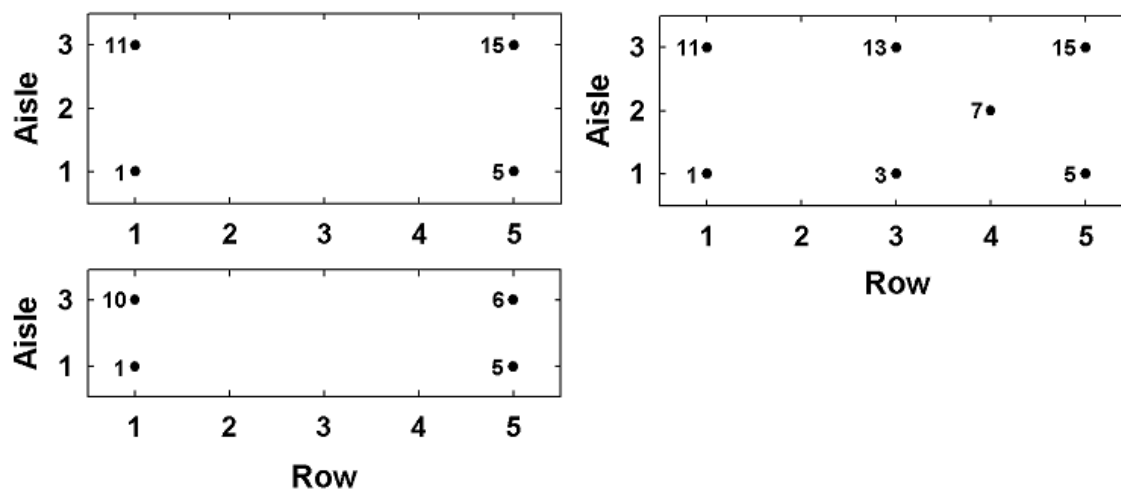
#### Sampling Methods:

Lesser house flies were sampled at three mink farms. Each farm consisted of a number of sheds of varying sizes. Sheds with two aisles were designated as narrow sheds, while those with three aisles were designated as wide sheds. Approximately half of the sheds housing mink were sampled at each farm. Five spot card sampling locations were established along each aisle within a shed. Sampling locations were initially numbered in the order they were checked (Fig. 1), but were assigned to rows within aisles for ease of analysis. Locations at the front and rear of the aisle were assigned to rows 1 and 5, locations at the centre of each aisle were assigned to row 3, the location between the front and centre assigned to row 2, and the location between the rear and centre was assigned to row 4.



**Figure 1:** Sampling locations within wide (upper panel) and narrow (lower panel) mink sheds. Numbers next to the dots indicate the spot card locations as recorded. Aisle and row numbers were assigned prior to analysis (Lysyk, 2007).

Spot cards (8 cm x 13 cm) were placed flush against the rafter at each location in the sheds. Each farm had the same layout for spot cards, dependant on the size of shed (15 for wide sheds and 10 for narrow sheds).



**Figure 2:** Sampling locations within wide (upper panel) and narrow (lower panel) mink sheds. Numbers next to the dots indicate the sticky ribbon locations as recorded (Lysyk, 2007).

Sticky ribbons (45 cm x 5 cm) were hung vertically from a rafter at the various locations as seen in Figure 2. The devices were placed out during May each year of the project and were replaced at approximately weekly intervals. The number of lesser house flies per ribbon and number of spots per card were counted when sample devices were collected and changed weekly.

Sampling was interrupted periodically for zoo-sanitary reasons, and a week interval between samples was not always achieved for this and operational reasons. To account for this, the sample counts were standardized to numbers per week as  $(\text{count}/\text{interval}) \times 7$  where interval = the duration in days the sample devices had been deployed. The standardized counts, lesser house flies/ribbon/week and spots/card/week were used as indices of abundance/activity.



## Results and Discussion

The fly species found on farm during this project were mainly the common house flies, *Musca domestica* L.; the lesser housefly, *Fannia canicularis* L.; blow flies, *Calliphora* species; and green bottle flies, *Phacenia* species. The lesser housefly, *Fannia canicularis* L. was determined as the main fly species present through the use of sticky ribbons.

It was found that weather/temperature and fly populations are directly related. As the temperatures increase during summer months, so do the abundance of flies. Farms 1, 2, and 3 exhibited population increases during mid-June, and increased abundance in July. The populations tended to spike in August and decrease during September and October. The temperatures spiked approximately one week prior to the fly outbreaks, indicating the presence of optimal fly breeding conditions, as a result of temperature, humidity, and potential food sources. It should indicate to producers that this is the time of year when Integrated Pest Management (IPM) due diligence is necessary. Integrated Pest Management (IPM) is a systematic decision-making process that supports a balanced approach to managing crop and livestock production systems for the effective, economical and environmentally-sound suppression of pests.

The second objective of this project was to determine whether the spot card method of assessing fly abundance and activity, used in poultry facilities, could be adapted to mink ranching. As stated by Dr. Lysyk, spot cards and sticky ribbons were correlated at all farms, therefore either could be used as an index of fly abundance/activity. The implementation of a particular sampling plan at a farm will require a number of decisions be made including what type of sampling device should be used.

Ribbons seem to be more useful for management purposes on-farm than spot cards. During analysis, ribbon indices had statistically significant association with complaints, while spot indices did not (Lysyk, 2010). As well, ribbons also provide mechanical control and are trapping the flies and could possibly be used as an alternative to chemical control.

It was found that spot cards tended to provide more variable indices within sheds and as a result, site selection became more important with spot cards compared with sticky ribbons. As a result, more spot cards than sticky ribbons were deployed on a farm to obtain an index of abundance with a fixed level of precision. However, the number of spots per card per week is far less than the number of flies captured per ribbon per week, so counting would require much less effort. Also, spot cards are more convenient and less messy to use than ribbons, and may have a greater rate of producer adoption (Lysyk, 2007).

## Fly Abundance

The mean number of spots per card per week and mean number of flies per ribbon per week were calculated for each farm using spot cards and sticky ribbons. These will be referred to as “spot indices” and “ribbon indices” respectively. Non-parametric ANOVA was used to compare the indices of abundance among farms and years.

The spot indices varied among farms and years with no significant farm/year interaction. Spot indices were greatest at Farm 1, and were similar between Farm 2 and Farm 3. Spot indices were lower during 2007 compared with 2008 and 2009. The lack of a significant farm/year interaction indicates this pattern was consistent among farms.

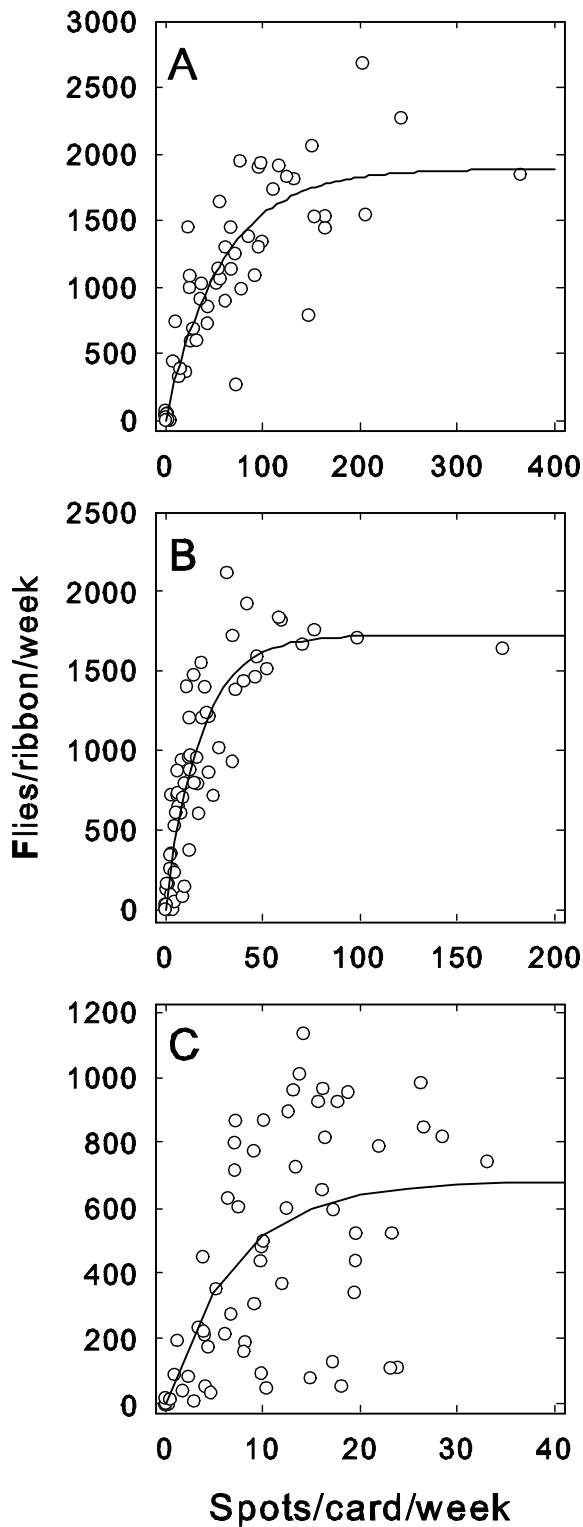
Ribbon indices also varied among farms and years with no significant farm/year interaction. Ribbon indices were greatest at Farm 1 and Farm 2, and least at Farm 3. The ribbon indices were also generally lowest during 2007 and greatest during 2008 and 2009.

Ribbon indices and spot indices were generally related, except that the relationship between the two varied among farms. The relationships are listed in Table 1, and illustrated in Figure 3. The relationships were strong for both Farm 1 and Farm 2, but much weaker for Farm 3. This may be an indication of variance in spot card placement between Farms 1 and 2 compared to Farm 3. This variance could be a direct result of barn design. The ribbon indices tended to increase sharply as spot card indices increased, then reach an upper asymptote as the ribbons became clogged with flies. The upper asymptote was ranged from 1,700 – 1,900 flies/ribbon/week at Farm 1 and Farm 2. This number was much lower at Farm 3, which was 700 flies/ribbon/week.

**Table 1.** Relationship between fly abundance indices at the three farms.

Farm	n	a ± SE	b ± SE	r <sup>2</sup>
Farm 1	57	1887.899 ± 146.219	0.017 ± 0.003	0.76
Farm 2	66	1725.399 ± 104.286	0.055 ± 0.008	0.80
Farm 3	65	682.870 ± 94.521	0.139 ± 0.052	0.40

Model is  $y = a*(1-\exp(-b*X))$  where  $y$  = mean flies/ribbon/week and  $X$  = mean spots/card/week.



**Figure 3.** Relationships between indices of fly abundance at three mink farms A) Farm 1; B) Farm 2; C) Farm 3. Solid lines are equation from Table 1 (Lysyk, 2010).

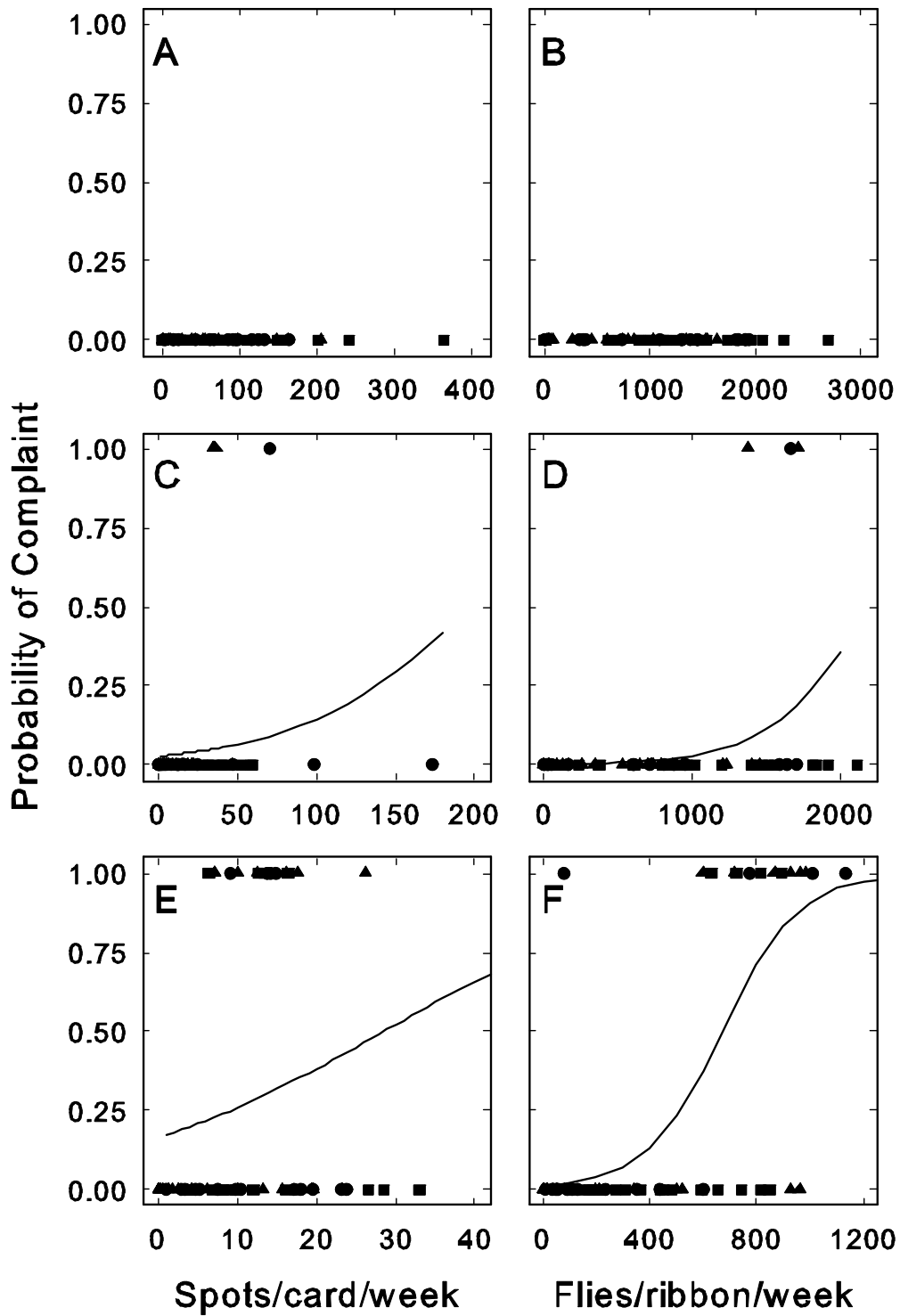
## Fly Complaints

Complaints were matched with indices of fly abundance that occurred on the earliest sample date prior to when the complaint was received. However, complaints were generally of two forms. Most complaints referred to a specific date, for example, “too many flies today”. These were directly associated with the indices of abundance that immediately preceded the complaint. Other complaints listed periods of time that flies were nuisances, for example, “flies were good in June and July and half way through August...” These periods were also associated with the indices obtained at the same time. The association between complaints and indices was made using a variable that took the value 1 if a complaint occurred immediately following the weekly index and 0 otherwise.

Although the fly indices at Farm 1 were greater than at the other two farms, no complaints were received during any of the 57 sample occasions. Complaints on Farm 2 occurred when the spot card index exceeded 34 spots/card/week or when the ribbon index exceeded 1,300 flies/ribbon/week (Table 2). Fly complaints were associated with 21 and 17% of the occasions when spot and ribbon indices respectively exceed the arbitrary thresholds for Farm 2. Most complaints occurred on Farm 3, when the spot index exceeded six spots/card/week, or when ribbon indexes exceeded 575 flies/ribbon/week (Table 2, Figure 4). A single complaint occurred when the ribbon index was 81 flies/ribbon/week. Fly complaints were associated with 40 and 68% of the occasions when indices exceeded the arbitrary thresholds at Farm 3.

**Table 2.** Number of weekly indices above and below arbitrarily defined complaint thresholds.

	<u>Spot Card Indices</u> Threshold	<u>Ribbon Indices</u> Threshold
Farm 1	not determined	not determined
Farm 2		
Below	(mean $\leq$ 34)	(mean $\leq$ 1300)
Above	(mean $>$ 34)	(mean $>$ 1300)
Farm 3		
Below	(mean $\leq$ 6)	(mean $\leq$ 575)
Above	(mean $>$ 6)	(mean $>$ 575)



**Figure 4.** Relationship between complaints and indices of fly abundance at three mink farms Figure A & B - Farm 1; Figure C & D - Farm 2; Figure E & F - Farm 3. Solid lines are equations from Table 3 (Lysyk, 2010).

Logistic regression was used to statistically relate the probability of a complaint to a weekly index. Results are listed in Table 3. No significant relationship was found between complaints and spot indices at Farm 2, but a marginally significant relationship with ribbon indices was found (Table 3). The relationship for the ribbon indices suggests that the probability of a complaint was 6% when the ribbon threshold of 1,300 was used (Table 4), and would exceed 20% at a threshold of 1,700 flies/ribbon/week.

**Table 3.** Relationship between abundance indices and the probability of complaints.

Index	a ± SE	b ± SE	P(b > 0)	AIC
Farm 2 (n = 66)				
Spots/card/week	3.583 ± 0.788	-0.018 ± 0.012	0.15	26.731
Flies/ribbon/week	6.577 ± 2.490	-0.003 ± 0.002	0.07	22.985
Farm 3 (n = 65)				
Spots/card/week	1.624 ± 0.516	-0.057 ± 0.035	0.10	77.957
Flies/ribbon/week	4.702 ± 1.166	-0.007 ± 0.002	0.01	46.882

Relationship is  $P(Y = 1) = 1/(1 + \exp(-(a + b \cdot X)))$  where  $X$  = the abundance index and  $Y = 1$  if a complaint occurred and 0 otherwise.

**Table 4.** Probability of a complaint at various levels of fly indices.

Spots/card/week	P(complaint)		Flies/ribbon/week	P(complaint)	
	Farm 2	Farm 3		Farm 2	Farm 3
1	0.0275	0.1726	50	0.0016	0.0124
2	0.0280	0.1808	100	0.0018	0.0171
3	0.0285	0.1894	150	0.0021	0.0235
4	0.0290	0.1982	200	0.0024	0.0323
5	0.0295	0.2074	300	0.0032	0.0602
6	0.0301	0.2169	400	0.0042	0.1093
7	0.0306	0.2267	500	0.0056	0.1905
8	0.0311	0.2367	600	0.0074	0.3109
9	0.0317	0.2471	700	0.0098	0.4639
10	0.0322	0.2578	800	0.0129	0.6239
15	0.0352	0.3157	900	0.0170	0.7608
20	0.0384	0.3798	1000	0.0224	0.8592
25	0.0419	0.4485	1100	0.0294	0.9212
30	0.0457	0.5192	1200	0.0385	0.9573
35	0.0498	0.5891	1300	0.0503	0.9773
40	0.0542	0.6556	1400	0.0656	0.9880
50	0.0643	0.7704	1500	0.0849	0.9937
100	0.1452	0.9828	1600	0.1094	0.9967
150	0.2957	0.9990	1700	0.1398	0.9983
160	0.3347	0.9994	1800	0.1770	0.9991
170	0.3762	0.9997	1900	0.2215	0.9995
180	0.4195	0.9998	2000	0.2735	0.9998

P(complaint) calculated using equations in Table 3.

The relationship between complaints and spot indices was not significant at Farm 3; however, the relationship between ribbons and complaints was significant (Table 3). This relationship indicates that the probability of a complaint was approximately 20% at the threshold of 575 flies/ribbon/week.

## Conclusions

It has been determined that the Lesser Housefly is the main nuisance fly species associated with mink ranches across the province of Newfoundland and Labrador. Monitoring the occurrence and abundance of nuisance flies is essential. Though it requires time and scheduling, it may foster better relationships within the community.

Ribbons are the preferred monitoring technique to be used on fur farms across the province. Ribbon indices had statistically significant association with complaints, while spot indices did not. Ribbons seem to be more useful for management purposes and may have a higher implementation rate by producers.

The thresholds varied among farms. No threshold could be determined for Farm 1 since no complaints were received. The thresholds established for Farm 2 were 34 spots/card/week when using the spot card index method. When using sticky ribbons, the threshold is 1,300 flies/ribbon/week. The thresholds established for Farm 3 when using the spot card index method was 6 spots/card/week and the threshold when using sticky ribbons is 575 flies/ribbon/week.

The threshold at Farm 2 was greater than that at Farm 3 and the probability of complaints much lower for a given level of abundance. These are compared in Table 4. There are several reasons for this including abundance of flies, dispersal patterns, proximity of residential communities and tolerance levels. The indices of abundance are the measure of relative abundance, and measure fly activity in an area, not the total fly population.

Fly dispersal is related to the total number of flies produced in an area. Secondly, fly dispersal to a neighboring area is often related to the proximity of residential communities from the fly source. The shorter the distance, the more likely flies are to invade the neighboring area, and this distance will vary from farm to farm. Thirdly, people vary in their tolerance for flies. The tolerance of those residents to the flies will vary based on how long they have resided at that location or whether they recently moved there from an urban or suburban neighborhood. As well, if the farm is growing in production, there is a higher possibility of lower tolerance with increased farm sizes.

For everyday operations of mink farms in Newfoundland and Labrador it is recommended that producers follow: The Environmental Best Management Practices (BMPs) for Mink Production in Newfoundland and Labrador, the General Checklist for Environmental BMPs on Mink Farms in Newfoundland and Labrador, as well as On-Farm Composting of Mink Carcasses.

The Environmental BMPs for Mink Production in Newfoundland and Labrador includes a number of factors including climatic conditions, moisture, manure management and farm logistics.



Climatic conditions directly influence the fly lifecycle; warmer temperatures speed up fly development; milder temperatures promote longer life spans. Wind direction and velocity may also play a key role in fly dispersal patterns. Finally, farm logistics and design also vary from farm to farm. Good site planning to utilize natural slopes and optimize drainage is key. Shed floors should be constructed to encourage efficient drainage and there should be adequate ventilation to encourage moisture removal from manures and other fly breeding media.

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