# 2019 Florida Southern Pine Beetle Forecast
## Florida Forest Service, Forest Health Section
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**Revised Edition 6/27/19**

A pheromone trap survey was conducted in March 2019 as part of an ongoing program to monitor the populations of Southern Pine Beetle (SPB) and its associated predators. The purpose is to provide an early-season prediction of the potential level of SPB activity in select Florida counties, and identify areas which may be at increased risk for an outbreak. The results of the 2019 survey predict that SPB the probability of SPB activity is low for Florida Forest Service Regions 1 and 3 with the potential for Moderate to High activity in Region 2.


**Fig. 1: Southern Pine Beetle (*Dendroctonus frontalis*)**

## Background:

The Southern Pine Beetle is one of the most destructive forest pests in the southern United States. Since 1995, the Florida Forest Service (FFS) has participated in an annual statewide Southern Pine Beetle (*Dendroctonus frontalis*, or SPB) spring trapping survey. This survey monitors numbers of adult SPBs and their clerid predators captured in pheromone-baited flight traps during the SPB primary spring dispersal phase. The results are used as an early-season prediction of SPB population trends and activity levels, allowing forest managers to identify areas of potential SPB activity in advance of aerial detection flights. The survey also provides data for monitoring SPB population levels from year to year.

Methods:

The 2019 Florida survey was conducted using from one to three traps (Lindgren funnel traps baited with alpha- and beta-pinene and the SPB aggregation pheromones frontalin and *endo*-brevicomin) in each of the 35 counties. Each trap was located in a different stand of susceptible forest type. *Endo*-brevicomin lures were added to all traps to boost attractiveness to SPB adults, thereby increasing trap catches and prediction accuracy (based on previous research). The 34 counties surveyed included those that are most likely to experience SPB problems based on historical outbreaks and/or their relative abundance of loblolly pines.

As in previous years, effort was made to place traps in stands containing sawtimber size loblolly pine or areas where loblolly pine is most abundant. Traps were distanced at least 40 feet from any pine tree and checked weekly by FFS foresters in March. Numbers of SPBs and their clerid beetle predators (*Thanasimus dubius*) were counted for each of the four weekly collections per trap.

There were many updates and changes to the 2019 survey. Florida joined with other Southern States to collect, report, and display the SPB trap survey results in a standardized format using the ESRI application Survey123 for ArcGIS. This standardization allows for a more uniform method which enables data to be more easily accessible and shared throughout different agencies and organizations. Southern Pine Beetle trapping results from all Southern States can be viewed at the following link: Southwide SPB Trapping Survey [2019].

2019 was the first year of application using a new model for predicting the risks of SPB damage (Appendix 1). This next generation prediction model is based on several predictor variables determined to work with the survey trapping data collected. Historical SPB data was also used to create a framework of parameters for development of the model. The current version of the model predicts risks of SPB impacts based upon spring trapping captures of SPB and clerids, the number of SPB spots last year, and the number of spots from the previous year (Table 1). The strongest effects on model predictions come from current year SPB captures and number of spots from the previous year.

## Results and Discussion:

The 2019 survey results predict low levels of SPB activity throughout most of Region 1 and 3. Both of these regions have historically had low levels of SPB activity in Florida and will likely continue that trend in 2019. No SPB were found in District 2 in the panhandle region of Florida which is likely due to a significant decrease in the density of pine habitat resulting from Hurricane Michael in 2018. This area may experience damage from Ips engraver (*Ips spp*.) beetle populations which will be attracted to localized pockets of surviving timber that have experienced a multitude of stressor factors from the hurricane event.

Region 2 in the northcentral and northeastern part of the State had the highest SPB trap counts for various counties located throughout the area. Nassau County was the only county to have a trap in the "High" category for the amount of SPB caught per trap per day (***Figure 1***). Mature loblolly located along low-level waterways in the northern section of Nassau county raises the potential risk for SPB activity in this area and should be monitored frequently. Region 2 additionally had moderate SPB/Trap/Day counts in Marion, Nassau, and Suwannee County.

The prediction model generated the highest probability of SPB activity for Region 2 (***Table 1***). Region 2 has experienced a high level of SPB activity over the past three years and is likely to continue that trend in 2019. The prediction model generates a probability percentage that SPB activity will occur and estimates approximately how many spots are likely happen. In addition, the model provides probability estimates that a county will experience more than 20, 50, and 150 spots.

Hamilton and Marion county both had a ~70% chance that some sort of SPB activity will occur in those areas (Table 1). Additionally, these two counties also had the highest prediction that these two counties will experience 50 or more spots (36% Marion and 32% Hamilton). Marion county had the third largest number of SPB/Trap/Day with an average of 378 SPB found in traps over a 14 day period.

Columbia, Levy, Nassau, and Suwannee counties all had a range of a 45-60% probability that some sort of SPB activity will occur in their county. Columbia, Levy, and Suwannee counties also had a probability estimate in the 15-25% range that 50 SPB spots or greater will occur in their area. While Clay county did not have the highest probability estimates for SPB occurring in this group, it is noteworthy to show that Clay had the second highest number of SPB/Trap/Day caught over a 14 day period with an average of 502.

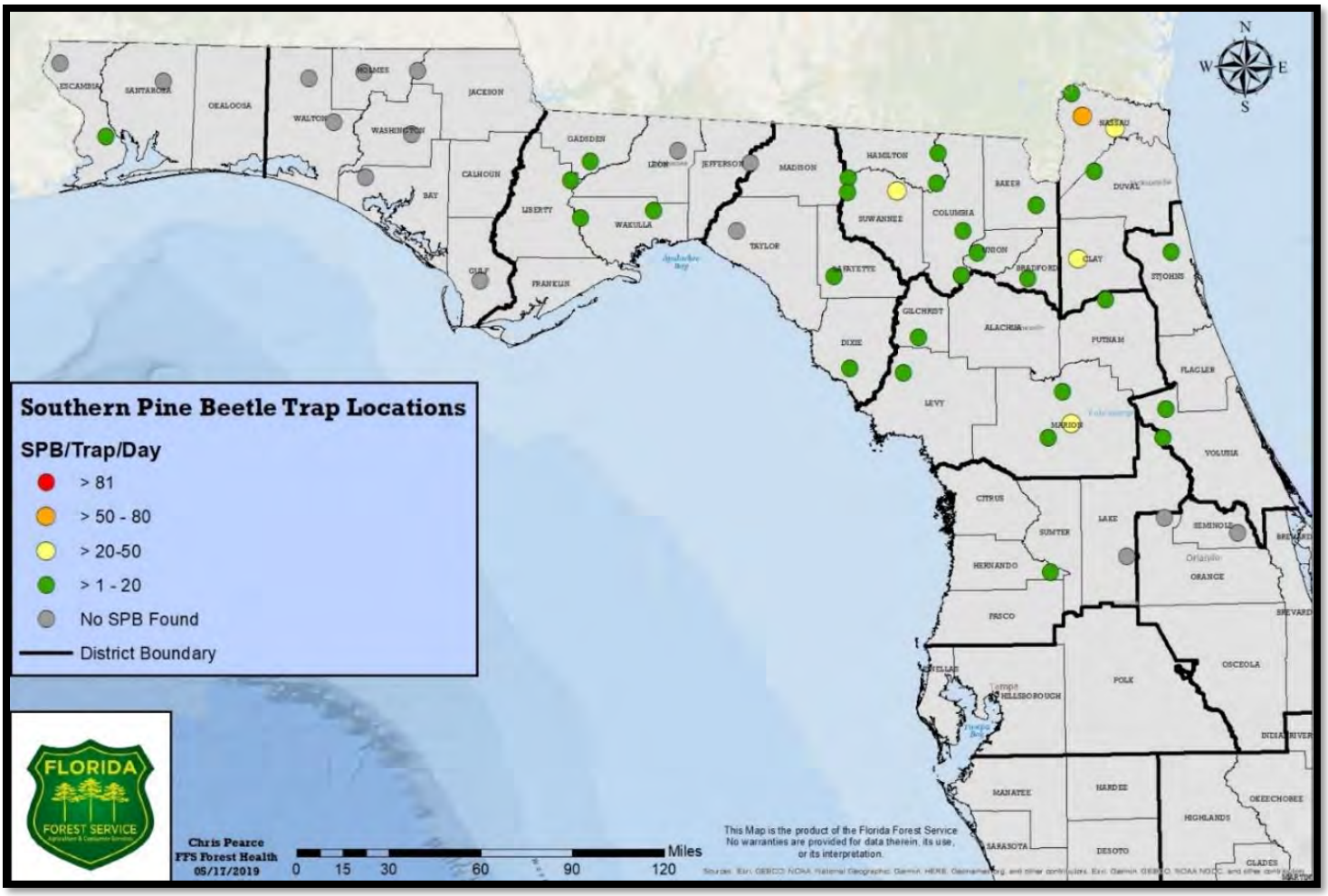
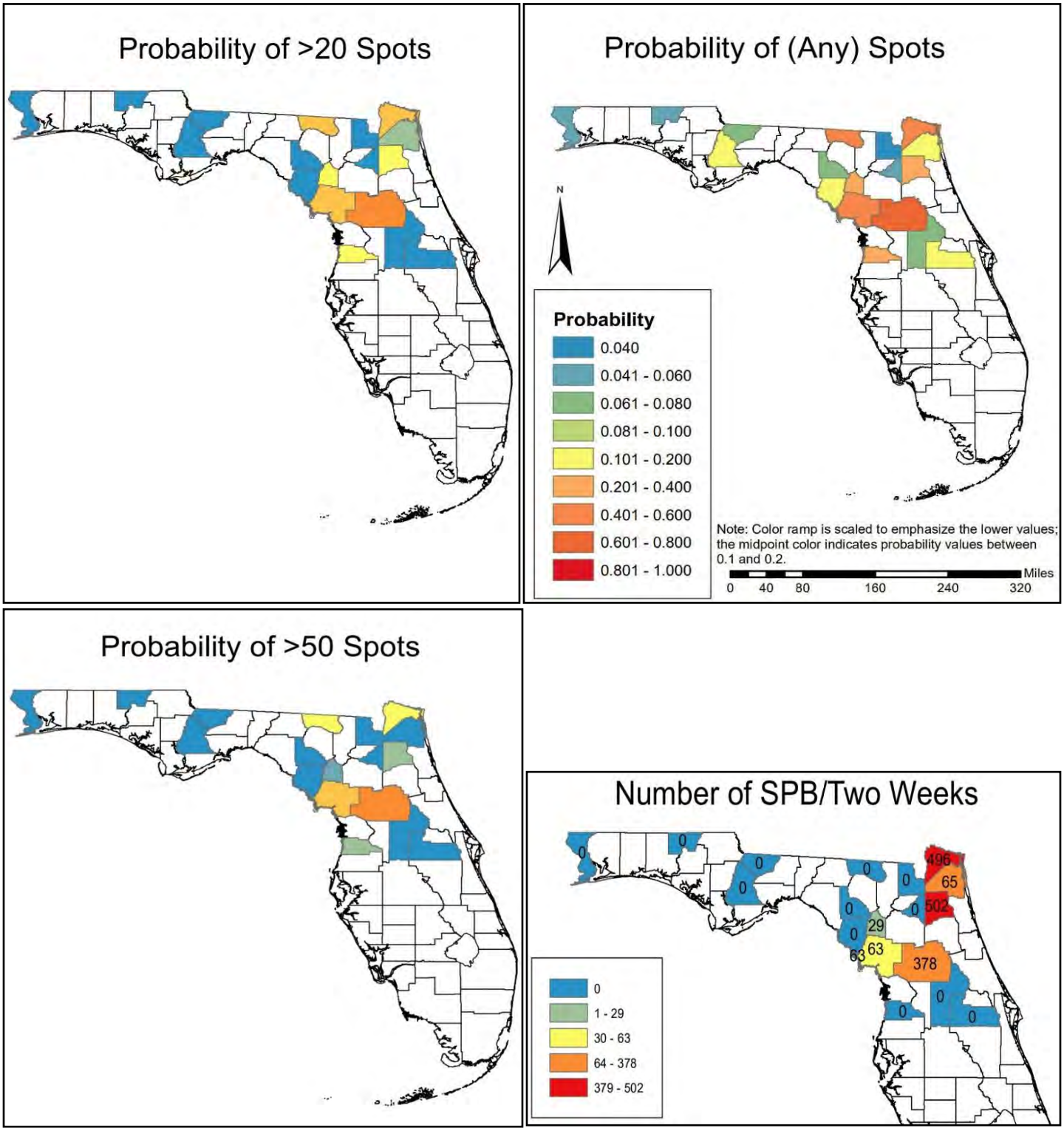



***Figure 2:*** **Southern Pine Beetle trap locations and the number of Southern Pine Beetle caught per day over a four-week period.**

***Table 1***: County level activity predictions generated from the southern pine beetle prediction model. The model is a next generation version of that which has been previously developed by Ron Billings, Texas Forest Service. The current version of the model predicts risks of SPB impacts for each county based upon the spring trapping captures of SPB and clerids, the number of spots last year, and the number of spots the previous year. The strongest effects on model predictions come from current year SPB captures and number of spots last year. The most informative single prediction is the probability of > 50 spots (P>50), which currently explains for the highest amount of variability within the historical data and may prove to be the more accurate of the predictions.

| Region/District | County and (#Traps) | SPB/ 14 Days | **Spots Last Year** | **Spots Two Years Ago** | **Probability of Any Spots** | **Approx. spots to expect if there are spots** | **Probability >20 Spots** | **Probability >50 Spots** | **Probability >150 Spots** |
|---|---|---|---|---|---|---|---|---|---|
| Region 1 | | | | | | | | | |
| Blackwater D-1 | Escambia (1) | 4 | 0 | 0 | 8% | 5 | 3% | 1% | 0% |
| D-1 | Santa Rosa (1) | 1 | 0 | 0 | 6% | 5 | 2% | 1% | 0% |
| D-1 | Okaloosa | 0 | 0 | 0 | 6% | 5 | 2% | 1% | 0% |
| Chipola D-2 | Bay (1) | 0 | 0 | 0 | 6% | 5 | 2% | 1% | 0% |
| D-2 | Gulf (1) | 0 | 0 | 0 | 9% | 6 | 3% | 1% | 0% |
| D-2 | Holmes (1) | 0 | 0 | 0 | 5% | 5 | 2% | 1% | 0% |
| D-2 | Jackson (1) | 0 | 0 | 2 | 7% | 5 | 2% | 1% | 0% |
| D-2 | Walton (2) | 0 | 0 | 0 | 4% | 4 | 1% | 1% | 0% |
| D-2 | Washington (1) | 1 | 0 | 0 | 6% | 5 | 2% | 1% | 0% |
| Tallahassee D4 | Wakulla (2) | 217 | 0 | 0 | 31% | 11 | 15% | 8% | 4% |
| D-4 | Gadsden (1) | 12 | 0 | 1 | 11% | 6 | 4% | 2% | 1% |
| D-4 | Liberty (1) | 180 | 5 | 0 | 39% | 14 | 21% | 12% | 6% |
| Region 2 | | | | | | | | | |
| Perry D-5 | Lafayette (1) | 5 | 0 | 1 | 9% | 5 | 3% | 1% | 0% |
| D-5 | Madison (1) | 106 | 0 | 0 | 25% | 9 | 5% | 6% | 2% |
| D-5 | Dixie (1) | 39 | 0 | 0 | 24% | 10 | 11% | 6% | 2% |
| D-5 | Taylor (1) | 0 | 0 | 0 | 4% | 4 | 1% | 0% | 0% |
| Suwannee D-6 | Baker (1) | 28 | 0 | 1 | 9% | 5 | 3% | 1% | 0% |
| D-6 | Bradford (1) | 157 | 0 | 0 | 23% | 9 | 10% | 5% | 2% |
| D-6 | Columbia (4) | 37 | 31 | 24 | 54% | 16 | 35% | 18% | 9% |
| D-6 | Hamilton (1) | 126 | 61 | 9 | 71% | 29 | 53% | 32% | 19% |
| D-6 | Suwannee (2) | 187 | 7 | 0 | 60% | 24 | 40% | 25% | 14% |
| D-6 | Union (1) | 32 | 0 | 0 | 11% | 6 | 4% | 2% | 1% |
| Jacksonville D7 | Clay (1) | 502 | 0 | 0 | 32% | 11 | 16% | 8% | 4% |
| D-7 | Duval (1) | 65 | 0 | 0 | 16% | 8 | 7% | 3% | 1% |
| D-7 | Nassau (3) | 572 | 1 | 2 | 46% | 15 | 30% | 15% | 7% |
| Waccasassa D8 | Gilchrist (1) | 29 | 1 | 0 | 24% | 10 | 11% | 6% | 2% |
| D-8 | Levy (1) | 63 | 19 | 2 | 57% | 21 | 36% | 22% | 12% |
| D-8 | Marion (3) | 378 | 25 | 0 | 72% | 36 | 57% | 36% | 22% |
| D-8 | Putnam (1) | 193 | 0 | 0 | 33% | 12 | 17% | 9% | 4% |
| Region 3 | | | | | | | | | |
| Bunnell D-10 | St. Johns (1) | 126 | 0 | 0 | 26% | 10 | 12% | 6% | 3% |
| D-10 | Volusia (2) | 13 | 0 | 0 | 17% | 8 | 7% | 3% | 1% |
| WFC D-11 | Hernando (1) | 25 | 4 | 0 | 37% | 14 | 27% | 11% | 5% |
| D-11 | Lake (1) | 0 | 0 | 0 | 7% | 5 | 2% | 1% | 0% |
| D-12 | Orange (1) | 0 | 0 | 0 | 11% | 6 | 4% | 2% | 1% |
| D-12 | Seminole (1) | 0 | 0 | 0 | 11% | 6 | 4% | 2% | 1% |

**Figure 3:** County level maps of predicted SPB activity from the southern pine beetle prediction model.




As in previous years, all counties in FFS Districts/Centers 1-12 have been asked (via a memo issued in April) to conduct an initial aerial SPB detection survey. Procedural guidelines for aerial surveys, ground checking, and reporting are available to Florida Forest Service foresters on the Forest Health website at: http://www.freshfromflorida.com/Divisions-Offices/Florida-Forest-Service/Our-Forests/Forest-Health/Forest-Insects/Southern-Pine-Beetle/Southern-Pine-Beetle-Aerial-Survey-Procedures

Because of limited survey inputs, a vast resource of potential habitat, and the limitations of the predictive model, the forecast presented here cannot be expected to be 100% accurate. Low SPB activity predictions do not guarantee that troublesome infestations will not develop on a local or limited basis in some counties. The SPB Prevention Program has been successful in reducing available habitat for the beetle by encouraging private landowners to thin overcrowded and stressed pine stands that favor SPB infestations. Foresters are urged to be on the lookout for localized and sporadic infestations on stands that are over-stocked, over-mature, or have poor soil drainage.

Sincere thanks to all the foresters who were involved in installing traps, making weekly collections, and submitting samples for processing. We would also like to acknowledge the continuing assistance from the US Forest Service and the work of Matthew Ayers (Dartmouth College) and Carissa Aoki (Bates College) for their work on the next generation SPB prediction model. Please forward any and/or all of this report to anyone you think may be interested.

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**Images below:**
Checkered clerid beetle (*Thanasimus dubius*), predator of the southern pine beetle (Left).
Lindgren funnel trap used to monitor southern pine beetle populations (Right).


## Appendix 1:

Southern Pine Beetle Prediction Model

$$\pi = \frac{e^{\beta_0+\beta_1\cdot X_1+\beta_2\cdot X_2+\ldots}}{1+e^{\beta_0+\beta_1\cdot X_1+\beta_2\cdot X_2+\ldots}} =$$ Probability of 0 spots from binomial element of Zero-inflated Poisson (ZIP).

$$\mu = e^{\beta_0+\beta_1\cdot X_1+\beta_2\cdot X_2+\ldots} =$$ Mean of Poisson function that estimates number of spots (in log units) if there are spots

| Parameter | | Binomial-model (π) | Count-model (μ) |
|---|---|---|---|
| *intercept* = | $B_0$ = | 0.3021 | 0.9450 |
| *SPB* = | $B_1$ = | -1.2839 | 0.2383 |
| *clerids.t1* = | $B_2$ = | 0.3914 | -0.0752 |
| *spots.t1* = | $B_3$ = | -1.1131 | 0.2411 |
| *spots.t2* = | $B_4$ = | -0.3992 | |

Prob(> 0 spots) considering binomial and count model
= 1 - (π + (1 - π) · Z)
Where Z = Prob(0 spots) from count model = POISSON.DIST(0,μ)

Expected number of spots if there are spots = μ

Prob(> 18 spots) = (1 - π) · PoissonCumdist(≥ 3, μ)

Prob(> 53 spots) = (1 - π) · PoissonCumdist(≥ 4, μ)

Prob(> 147 spots) = (1 - π) · PoissonCumdist(≥ 5, μ)

Prob(> 402 spots) = (1 - π) · PoissonCumdist(≥ 6, μ)

Prob(> 1095 spots) = (1 - π) · PoissonCumdist(≥ 7, μ)

Prob(> 2979 spots) = (1 - π) · PoissonCumdist(≥ 8, μ)