Hayne Line Transect Estimator

The Hayne estimator was develop to estimate density of birds that flush as an observer comes within a certain radius. This method assumes that there is a fixed flushing distance $r$ and all animals within $r$ distance of the observer will flush.

![Sample area boundary](image)

**Figure 1.** Illustrating the layout and important measures for the Hayne line transect estimator.

The density is estimated by:

$$\hat{D}_H = \frac{n}{2L} \left( \frac{1}{n} \sum_{i=1}^{n} \frac{1}{r_i} \right)$$
where:

\( D_H \) is the Hayne density estimate

\( n \) is the number of animals

\( L \) is the length of the transect

\( r_i \) is the sighting distance to the \( i^{th} \) animal.

\( R \) is the mean of the reciprocal of the sighting distances and is calculated as:

\[
R = \frac{1}{n} \sum_{i=1}^{n} \frac{1}{r_i}
\]

The variance of the density estimate is calculated as:

\[
Variance(\hat{D}_H) = D_H^2 \left[ \frac{\text{var}(n)}{n^2} + \frac{\sum_{i=1}^{n} \left( \frac{1}{r_i} - R \right)^2}{R^2 n(n - 1)} \right]
\]

where:

\( D_H \) is the Hayne density estimate

\( n \) is the number of animals

\( \text{var}(n) \) is the variance of \( n \) approximately equal to \( n \)

\( r_i \) is the sighting distance to the \( i^{th} \) animal.

The standard error of the mean density is estimated by the square root of the variance.
Hayne method assumed that the mean sighting angle is 32.7°. This can be tested by:

\[ Z = \frac{\sqrt{n}(\bar{\theta} - 32.7)}{21.56} \]

where:

Z is the standard normal deviate test value
n is the number of animals sighted
\( \bar{\theta} \) is the mean observed sighting angle (Figure 1).

The test would be if the Z value is greater than 1.96 or less than -1.96 the sighting angle is statistically different than 32.7° at the alpha = 0.05 level.

Also See:

Chapter 2 - Estimating Abundance: Line Transects pages 115-121 in: