Newcomb, HR. 1940. Ring-necked pheasant studies on Protection Island in the Strait of Juan de Fuca, Washington. MS thesis. Oregon State University.

-----Hugh Ross Newcomb--------for the--M.S.---in Fish & Game Mgt.
(Name) (Degree) (Major)

Date Thesis presented--April 21, 1940

Title---Ring-Necked Pheasant Studies on Protection Island----
----------in the Strait of Juan de Fuca, Washington-----------

Video

Photo credit: Andy Vernon

Photo credit: Lukasz Lukasik

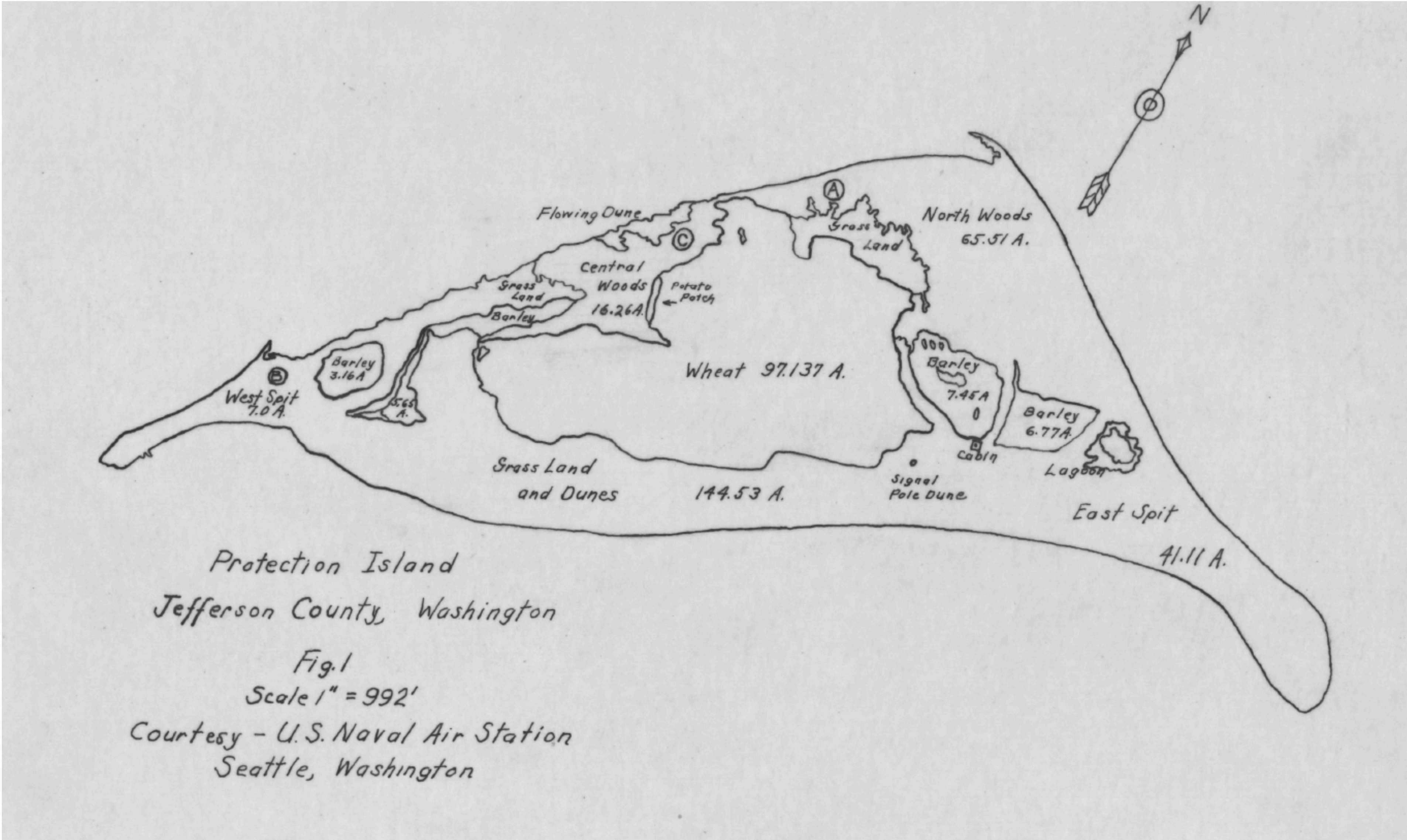

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Fig. 15

Typical owl kill
Young female pheasant
found August 17, 1939

Fig. 16

Typical pheasant
feeding on potatoes
July 29, 1939

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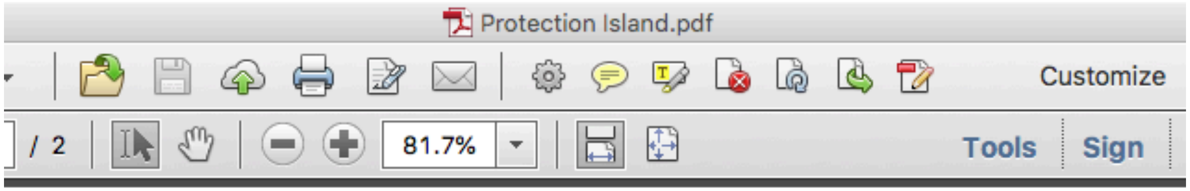
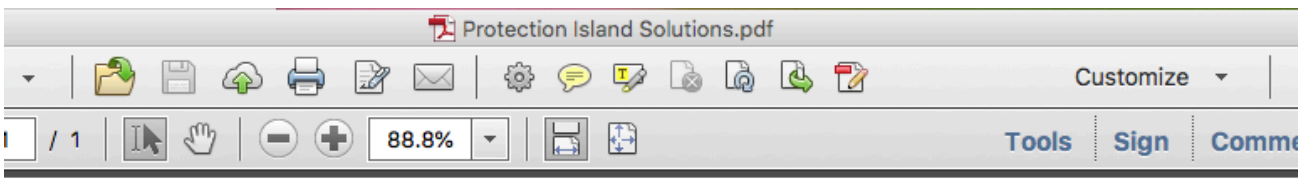


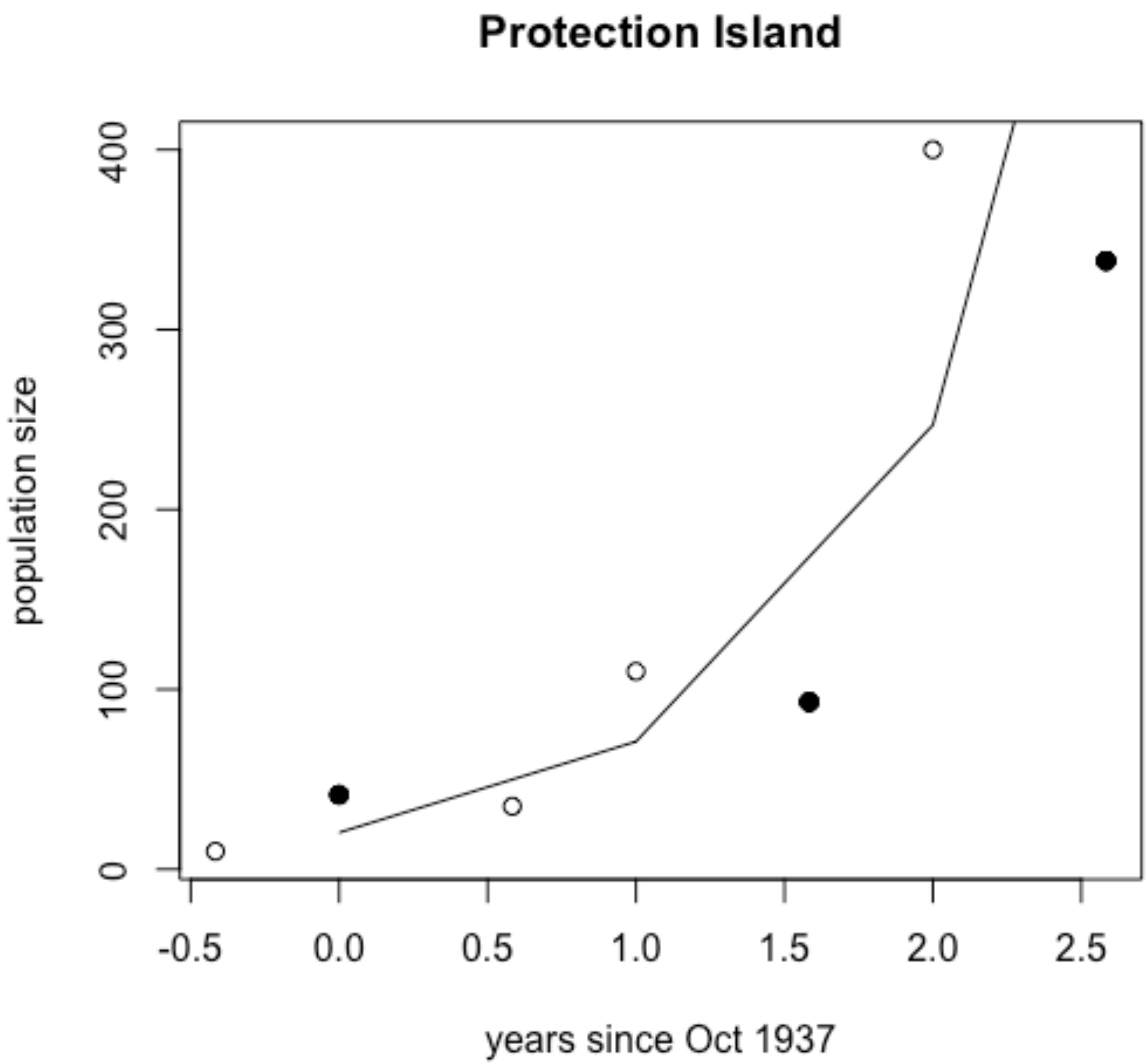
The information below is taken from the following source:
Newcomb, HR. 1940. Ring-necked pheasant studies on Protection Island in the Strait of Juan de Fuca, Washington. MS thesis. Oregon State University.

a. Pheasant chicks are born during the summer.
b. In May 1937, 10 pheasants were introduced to the island. Before the next breeding season there were 35.
c. November 10, 1938 a census estimated 110 pheasants.
d. October 13, 1939 a census estimated 400 pheasants.
e. Between the 1938 and 1939 censuses, Newcomb observed that 17 adult birds died.
f. During the 1938 nesting season: 5.86 eggs/nest. 83.57% of eggs hatched.
g. During the 1939 nesting season: 8.73 eggs/nest. 64.58% hatched. Average number of chicks per clutch was 6.93.
h. During the 1939 nesting season: Average number of chicks per clutch was 6.93.[1]
i. You can assume the sex ratio is 50:50 male to female. Pheasants are a sexually reproducing species.



Protection Island - SOLUTIONS

1. Census is in October-November: fall. This is after the breeding season, and so the number of eggs/chicks that survive to the next census should be relatively close to 1.
2. I assume the 35 count occurred on May 1938.
3. d = 17/110. This assumes that the mortality between the 1938 and 1939 census reflects the mortality for all years.
4. b is defined as the number of chicks per adult surviving to the census in October-November. g. suggests 8.73 x .645 = 5.63 eggs hatching per nest, however, this is larger than the number of chicks per clutch reported in h. f. suggests 5.86 x .836 = 4.90 eggs hatched per nest. I have ignored h. because it is the higher g. and, therefore, less likely to include post-hatching survival of chicks. b should be constant across years so we will take the average of b calculated in 1938 and 1939 from f. and g. Let n be the number of individuals per nest. We will assume n = 2, however, as the population is polygamous this is not clear.
   b_{1938} = 5.63/n = 2.815 eggs hatched per individual in 1938
   b_{1939} = 4.90/n = 2.45 eggs hatched per individual in 1939



Protection Island
population size
0
100
200
300
400
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
years since Oct 1937

Geometric growth

$$N_t = \lambda^t N_0 \qquad\qquad N_{t+1} = \lambda N_t$$

- The equations we have seen so far are called ‘discrete time’. This equation is appropriate for populations that have regular, pulse reproduction.
- For example, pheasants reproduce once per year in the summer.
- Can you think of examples of other species that reproduce like this?

Exponential growth

- Can you think of any species that reproduce continuously throughout the year?
- These species are better modelled with a continuous time model

Derive $dN/dt = rN$

From $N_{t+\Delta t} = \lambda N_t$

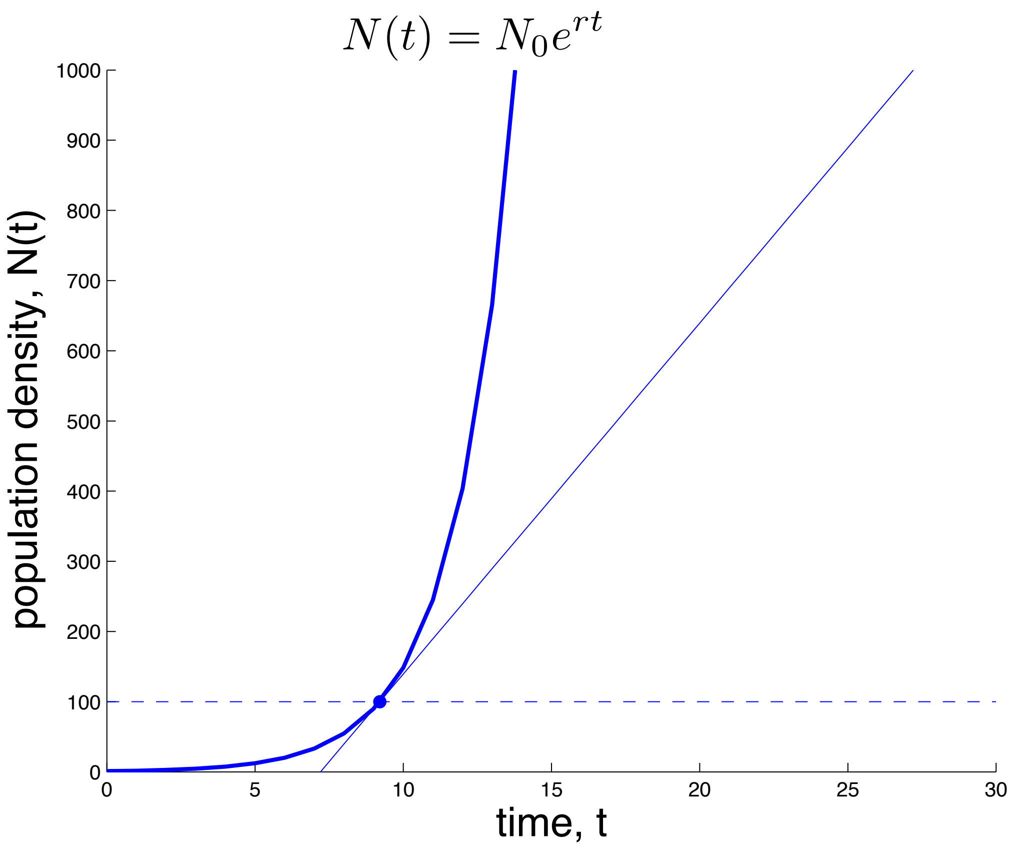
Exponential growth (continuous time)

Let $N(t)$ be the popn size at time t

$$\frac{dN(t)}{dt}$$

- The slope of a graph of population size versus time
- The instantaneous rate of change in the popn size, $N(t)$

Exponential growth



- The population is growing exponentially with time

$$\frac{dN(t)}{dt} = rN(t)$$

- $r = 0.5$
- What is the slope of the tangent line?

Solve $dN/dt = rN$

To get $N(t) = N(0)e^{rt}$

Exponential growth in continuous time

$$\frac{dN(t)}{dt} = (b - d)N(t)$$

$$\frac{dN(t)}{dt} = rN(t)$$

- b: is the per capita birth *rate* (1/time)
- d: is the per capita death *rate* (1/time)
- $r = b$-d: intrinsic *rate* of natural increase (1/time)

Discrete time

$$N_{t+1} = \lambda N_t$$

- The population is increasing if $N_{t+1} > N_t$
- For what values of λ does the population size increase?

Continuous time

$$\frac{dN(t)}{dt} = rN(t)$$

- The population is increasing if $\frac{dN(t)}{dt} > 0$
- For what values of r does the population size increase?

Discrete time

$$N_{t+1} = \lambda N_t$$

$$N_t = \lambda^t N_0$$

1. Used for populations that have regular pulse reproduction, e.g. pheasants
2. The population is increasing if $N_{t+1} > N_t$
3. λ is non-negative (positive or zero)
4. Popn grows if $\lambda > 1$
5. $\lambda = 1+b-d$ and is called the finite rate of population growth

Continuous time

$$\frac{dN(t)}{dt} = rN(t)$$

$$N(t) = N_0 e^{rt}$$

1. Used for populations that reproduce continuously, e.g. bacteria
2. The population is increasing if $\frac{dN(t)}{dt}$ > 0
3. r can be positive or negative
4. Popn grows if r > 0
5. $r = b\text{-}d$ and is called the intristic rate of natural increase

Summary

- Exponential growth assumes that all individuals in the population have the same chance of dying and produce the same number of offspring. These do no change over time.

- We can use the mathematical formulas to predict the size of the population in the future