Digital Atlas of Seal Haul-out Sites in Maine: 1981-2001

December, 2005

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Of
Seal Haul-out Sites in
Maine: 1981 - 2001

Harbor seals hauled out on a small ledge
off the coast of Maine. Cover Photo: James Gilbert

Citation:

Dow, W. E. 2005. Digital Atlas of Seal Haul-out Sites in Maine: 1981-2001. Nicholas School of the Environment and Earth Sciences. Duke University Marine Laboratory. Masters of Environmental Management Masters Project.

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Harbor seal. Photo: Ari Friedlaender

About the Atlas

The Maine Coast

The Atlas covers the coastal waters of Maine, from the Isles of Shoals at the New Hampshire-Maine border to Cobscook Bay at the United States-Canada border (Figure 1). From Cape Elizabeth south the coastline is comprised primarily of sandy beaches. North of Cape Elizabeth the coastline is rocky, carved by glaciation into a complex coastline. The 5,600 kilometers of coastline between the Isles of Shoals and Cobscook Bay has many bays and over 3,500 islands and rock ledges. Seals can be found on many of these islands and ledges, but prefer those uninhabited by people. Diurnal tides range from 2.6 meters South of Cape Elizabeth to 5.9 meters in Cobscook Bay. Many of the ledges that seals utilize are submerged at high tide.

Collection of Data

Aerial surveys were conducted between 1981 and 2001 (Table 1). Seals and pups were identified from the aircraft and then counted using photos (slides) taken during the flight. The number of seals at each site was determined by replicate counts of the site slide made by more than one researcher, to determine the minimum and maximum number of pups. The total number of seals accounts for both adults and pups, thus the number of harbor seal adults is the total number minus the pup count. The minimum and maximum counts were averaged to provide a best estimate. When gray seals started appearing during surveys (in 1997) on the Maine coast researchers also estimated the minimum and maximum number of gray seals. If there were small discrepancies in researcher counts (< 2), the counts were averaged. Large discrepancies required a recount until discrepancies could be accounted for. It is important to remember that aerial surveys are “snapshots” in time and seals may be present in areas, but not sighted on the particular days surveyed.

Aerial surveys were conducted during two hours on either side of low tide as this is when the highest number of seals is expected to be hauled out (Watts 1996). When possible, surveys were conducted when low tides occurred at midday, as time of day can also affect the number of seals hauled out. Surveys were conducted during both the early spring (March), early summer (May-June pupping season for Harbor seals) and late summer (August molting season for Harbor seals). Survey paths were the same in all seasons.

During pupping season the harbor seal population segregates by age and gender and counts during this season are sensitive to the timing of the survey relative to peak pupping time, which can vary from year to year (Kovacs *et al.* 1990, Bowen *et al.* 2003, Dube *et al.* 2003). Surveys conducted during molting season may also be sensitive to peak molting time as males and females may molt at different times (Daniel *et al.* 2003). Temperature, height of tide, wind and other factors can also influence the number of seals hauled out (Schneider and Payne 1983, Frost *et al.* 1999, Boveng *et al.* 2003). Several studies have also found that the amount of time a seal spends hauled out varies with sex

and age (Thompson *et al.* 1997, Harkonen *et al.* 1999, Harkonen and Harding 2001, Huber *et al.* 2001, Boveng *et al.* 2003).

These survey data were collected over many years by different researchers, so there has been some variation in the manner in which observations were made and recorded. For example, islands and ledges were divided as haul-out sites grew, but labeling was not always consistent and sites were not recorded uniformly across sampling years. In such cases the divided sites were combined. If the data was recorded uniformly a pre-split record was created for those years before division occurred. For ease of surveying and data analysis (population estimation) the Maine coastline was divided into 12 regions (Figure 1).

Latitude and longitude coordinates for each haul-out site were recorded and compiled with seal counts from each survey. The database file was saved as a dBase file and point layers were generated (using ESRI ArcGIS 9.0 software and tools) from these files for each survey (Figures 2-13) and for all surveys combined.

How to use the Atlas

Observations are recorded by individual survey day. When more than one count was made on a single day replicates are labeled A, B, and so on. Prior to1997 only harbor seals were seen during the survey and each survey day is divided into S (seals – harbor seals) and P (pups). The count in the Seals column includes the Pup count. In 1997 and 2001 survey days are split into three columns: HS (Harbor seals), GS (Gray seals) and P (pups). Again, the Pup count is included in the Harbor seal count as gray seal pups are born in January and February and thus not present during these survey periods.

All data can be downloaded and viewed at the OBIS-SEAMAP web site (http://seamap.env.duke.edu) using the program Google Earth. At this site the data are grouped by survey and region. Graphs showing the counts for seals over time in each region can be viewed by clicking on each individual region and choosing Harbor seal, Gray seal or Pup.

The data and point layers can also be viewed or manipulated using ArcMap or ArcExplorer. All shapefiles are in the North American Datum NAD 1983, Geographic projection and units are in decimal degrees (Figures 2-13).

Species Profiles

Species profiles can be found on the OBIS-SEAMAP website (http://seamap.env.duke.edu) and at the sites below.

Harbor seals (*Phoca vitulina*)

http://seamap.env.duke.edu/species/tsn/180649

Harbor seal and pup. Photo: Ari Friedlaender

Gray seals (*Halichoerus grypus*)

http://seamap.env.duke.edu/species/tsn/180653

Gray seal and pup. Photo: James Gilbert

Applications of the Atlas

The Atlas is designed for use by researchers and managers. Little is known about the relationship between environmental factors and habitat use. The Atlas should be used for several research objectives. For example, the atlas could be used to explore relationships between prey abundance and haul-out site or to explore differences between haul-out sites with pups and those without pups. As seals are increasing in number and range the atlas could be used as a tool for managers who would like to predict where seal and human conflicts may arise.

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Tables and Figures

Table 1. Date of surveys and regions examined in count of seals on the coast of Maine.

Year of survey	Dates	Region Covered
1981	15 – March	All of coastal Maine
	8 -18 June	All of coastal Maine
1982	17 -19 May	All of coastal Maine
1986	17 -23 March	All of coastal Maine
	15 -21 June	All of coastal Maine
1993	28 May - 11 June	All of coastal Maine and Isles of Shoals
	6 -14 August	All of coastal Maine and Isles of Shoals
1997	27 May - 4 June	All of coastal Maine and Isles of Shoals
Replicate survey	9 -10 June	Segments of Penobscot Bay
	9 -14 August	All of coastal Maine
2001	27 May - 4 June	All of coastal Maine and Isles of Shoals
Replicate survey	27 May - 1 June	Penobscot Bay, Blue Hill, and Cobscook Bays

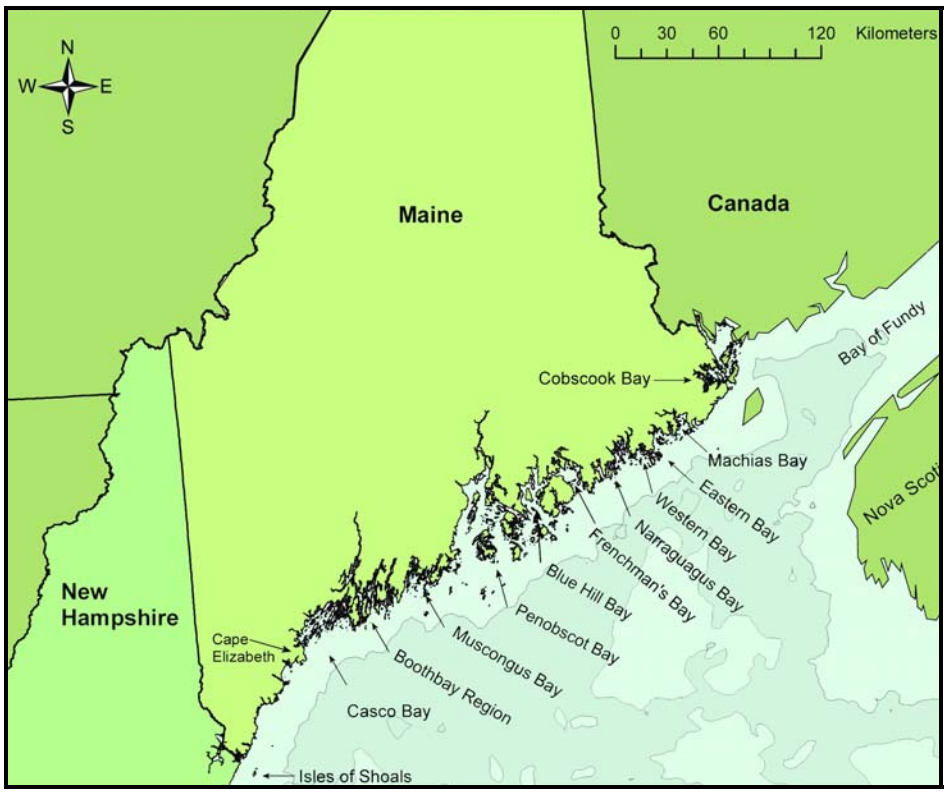
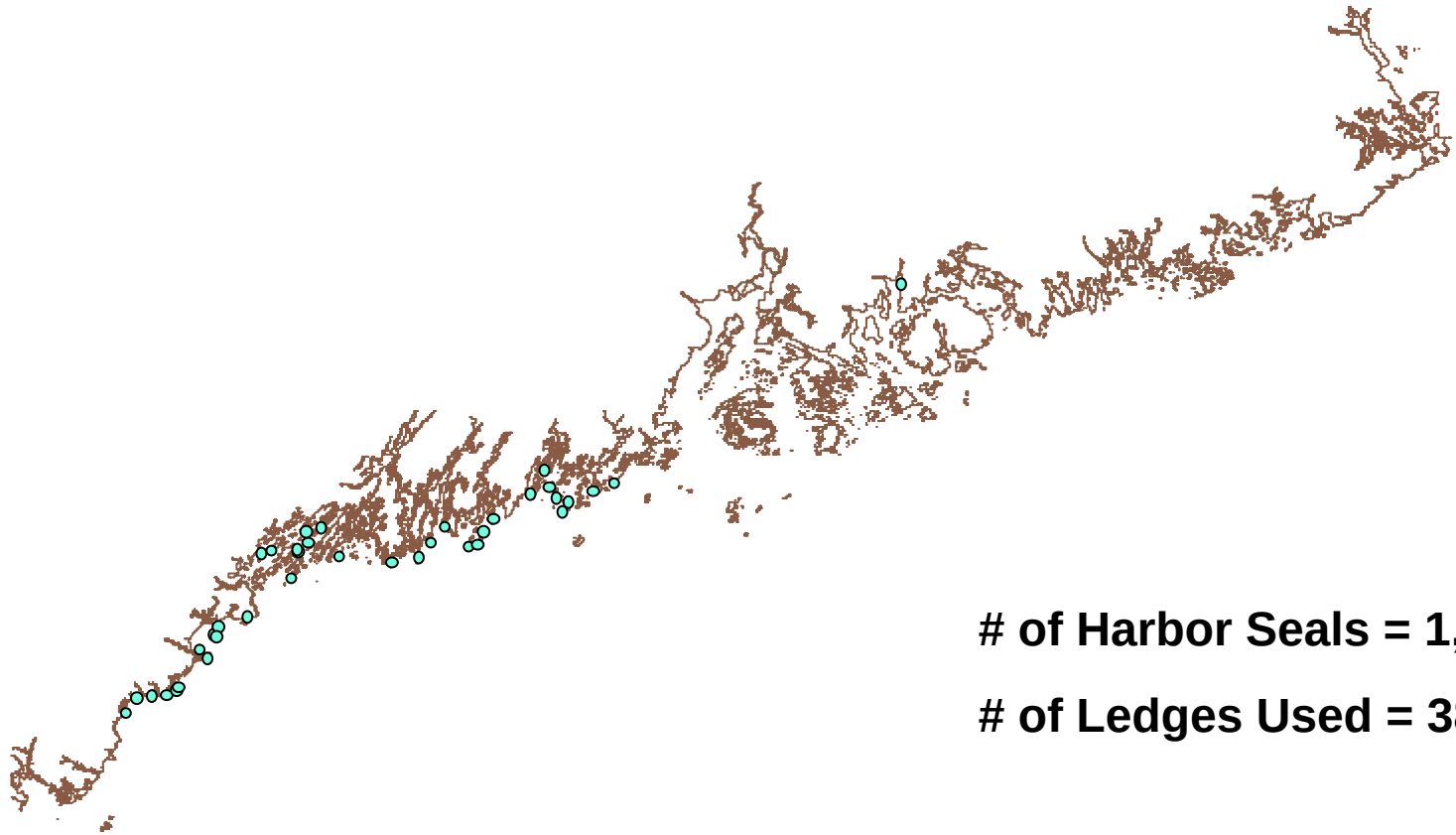


Figure 1. Locations of the bays along the coast of Maine that were used to subdivide the seal survey study area.

Figure 2. 1981 Survey dates: March 15
Area Surveyed: All of Coastal Maine



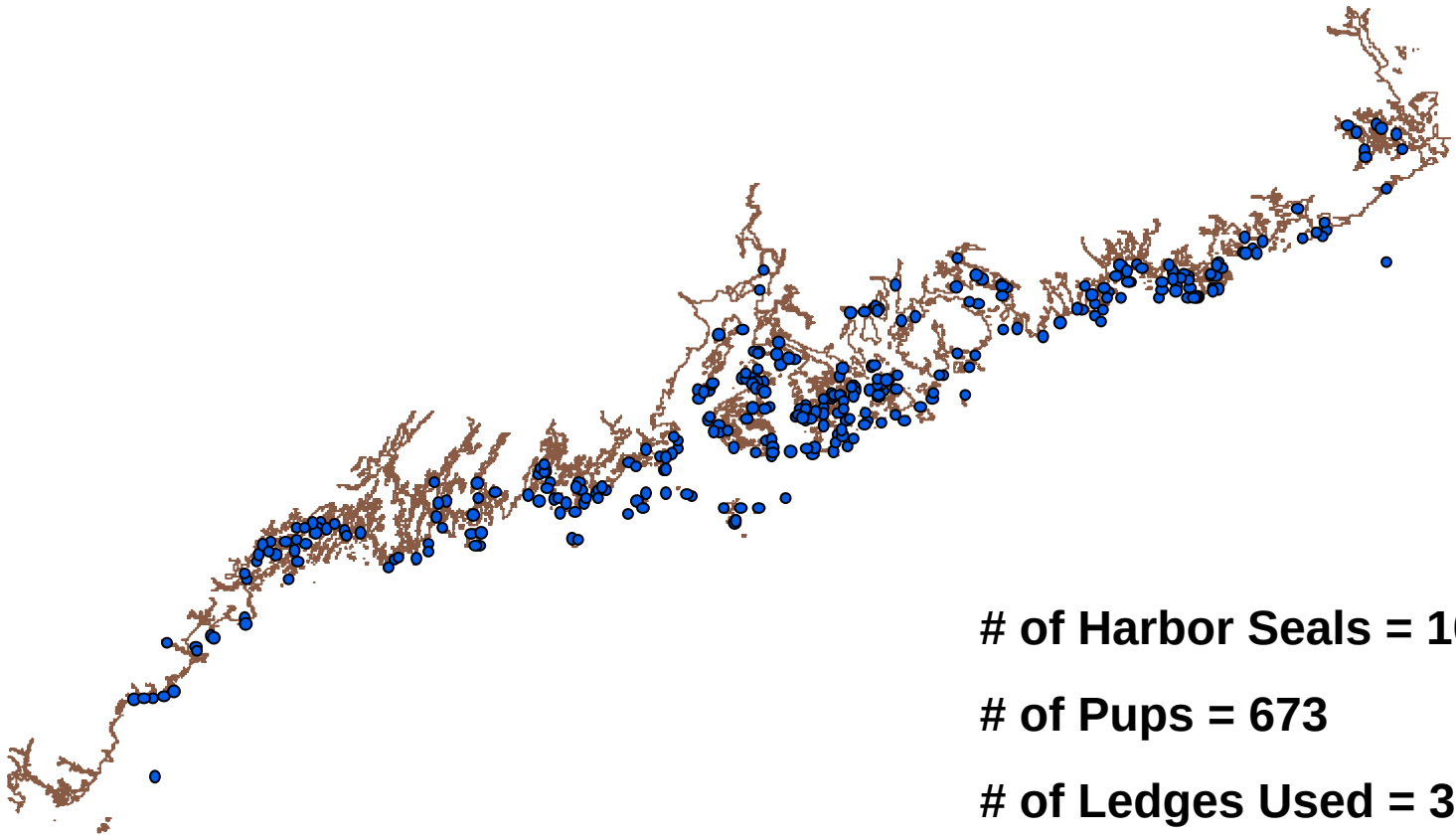
# of Harbor Seals = 1,285

# of Ledges Used = 38

60 30 0 60 Miles

N
W E
S

Figure 3. 1981 Survey dates: May 8,10,11,12 and 18
Area Surveyed: All of Coastal Maine



# of Harbor Seals = 10,511

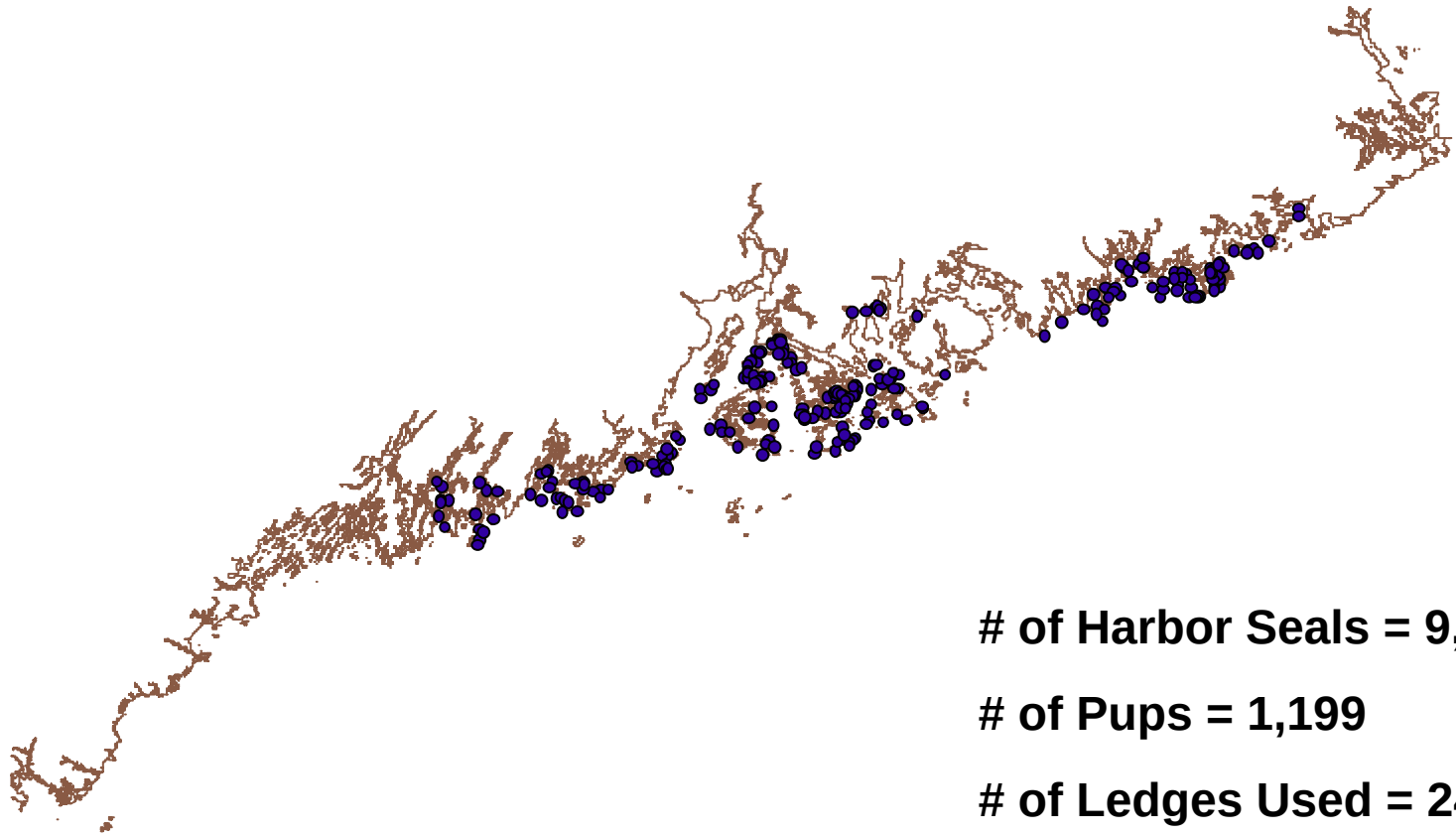
# of Pups = 673

# of Ledges Used = 325

60 30 0 60 Miles

N
W E
S

Figure 4. 1982 Survey dates: May 17, 18 and 19
Area Surveyed: All of Coastal Maine



# of Harbor Seals = 9,327

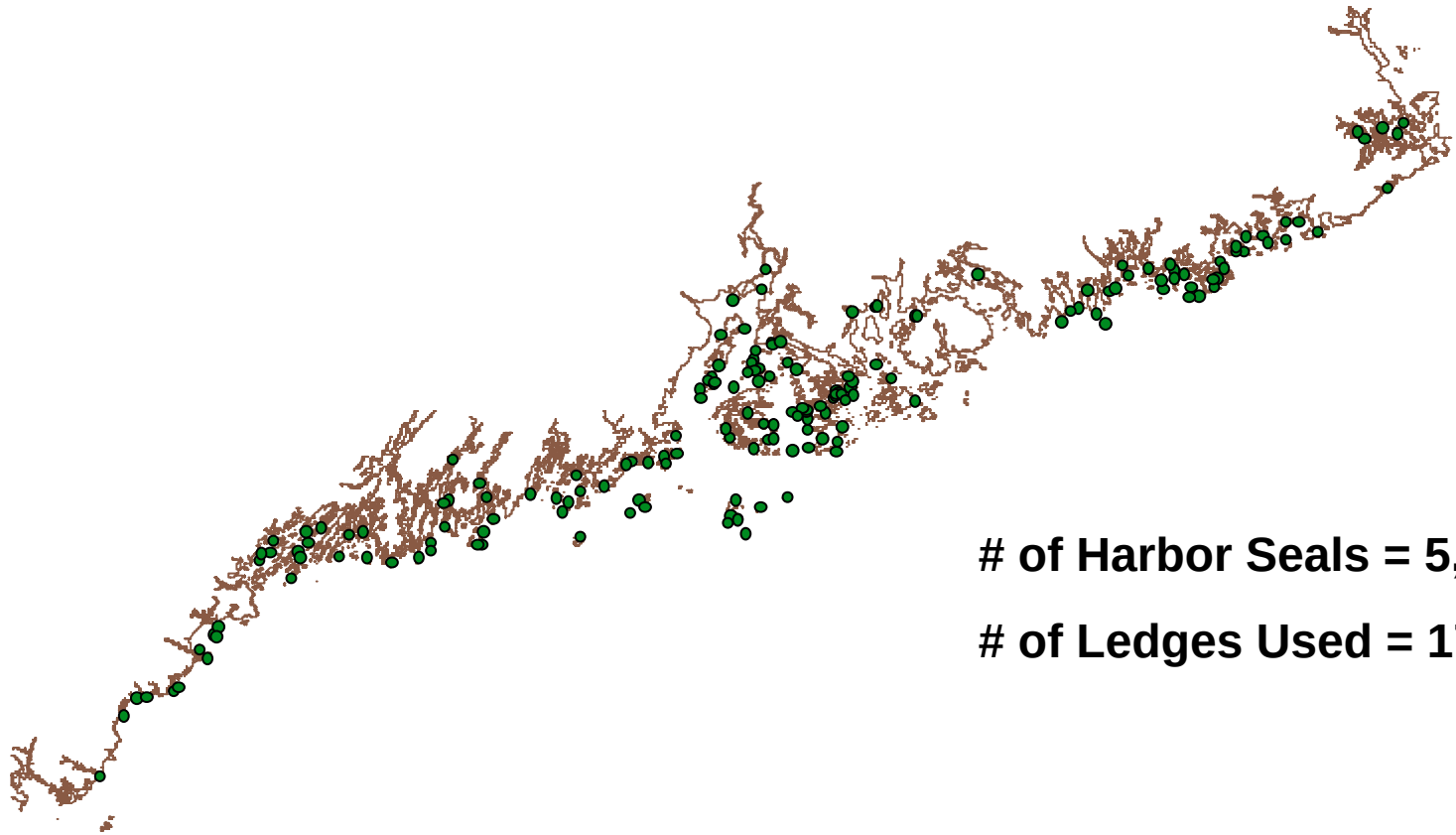
# of Pups = 1,199

# of Ledges Used = 240

60 30 0 60 Miles

N
W E
S

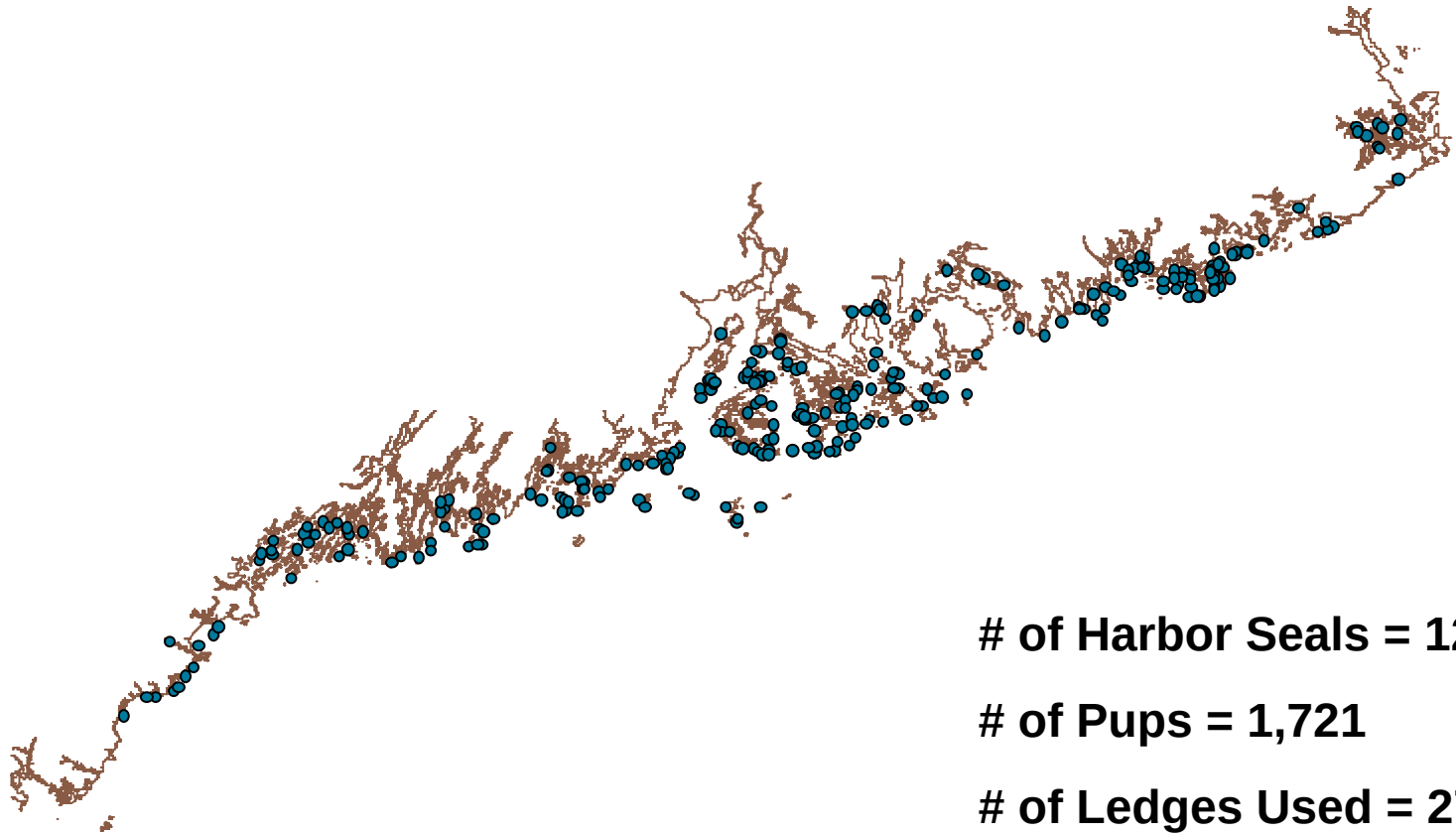
Figure 5. 1986 Survey dates: March 17, 18, 21, 22 and 23
Area Surveyed: All of Coastal Maine



# of Harbor Seals = 5,201

# of Ledges Used = 175

Figure 6. 1986 Survey dates: June 15, 18, 19 and 21
Area Surveyed: All of Coastal Maine

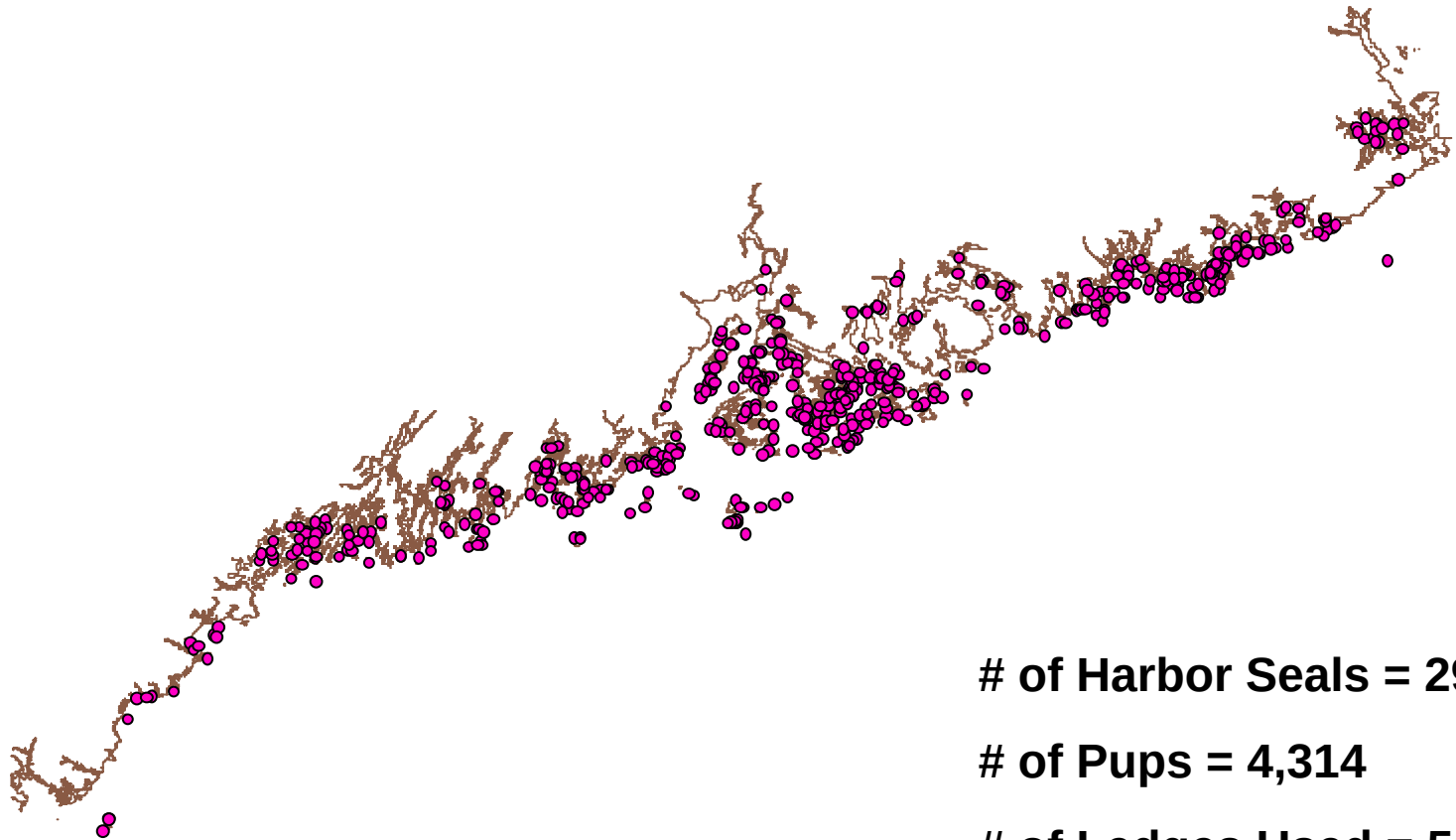


# of Harbor Seals = 12,931

# of Pups = 1,721

# of Ledges Used = 276

Figure 7. 1993 Survey dates: May 28, 31, June 3, 4, 9 and 11
Area Surveyed: All of Coastal Maine and Isles of Shoals



# of Harbor Seals = 29,509

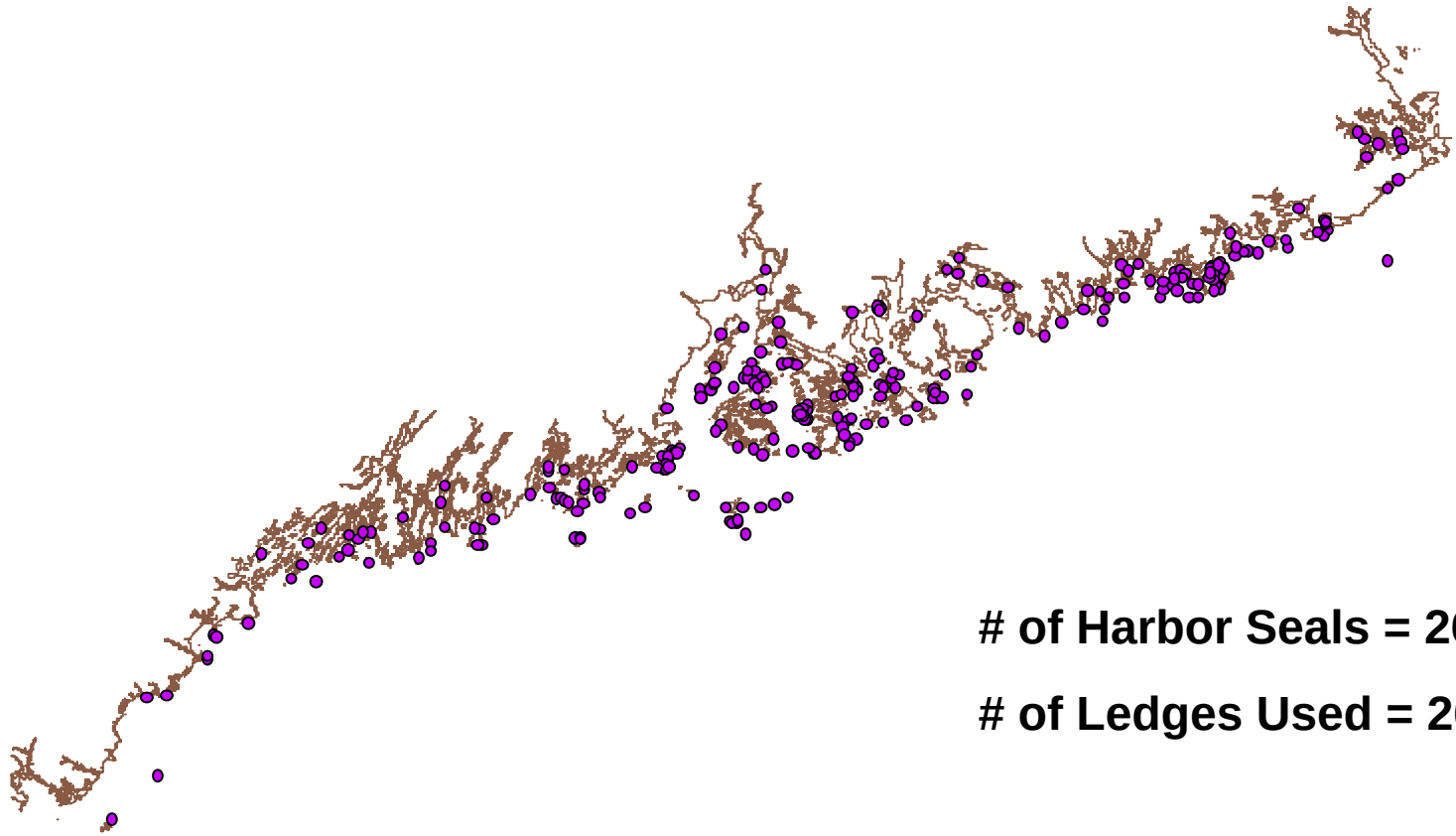
# of Pups = 4,314

# of Ledges Used = 540

60 30 0 60 Miles

N
W E
S

Figure 8. 1993 Survey dates: August 6, 7, 8, 13 and 14
Area Surveyed: All of Coastal Maine and Isles of Shoals



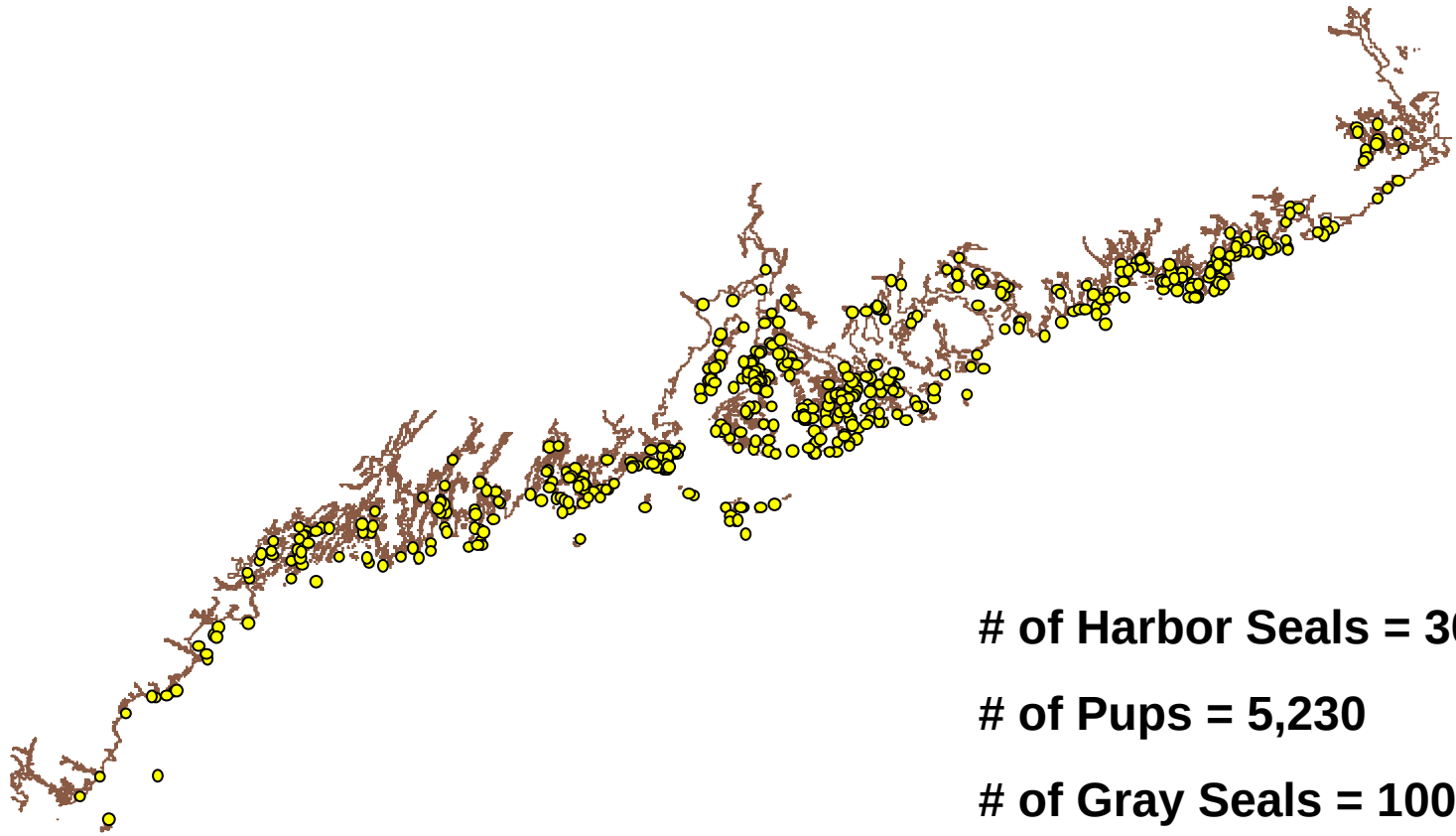
# of Harbor Seals = 26,159

# of Ledges Used = 260

60 30 0 60 Miles

N
W E
S

Figure 9. 1997 Survey dates: May 27, 28, 29, 30, June 2, 3 and 4
Area Surveyed: All of Coastal Maine and Isles of Shoals



# of Harbor Seals = 30,574

# of Pups = 5,230

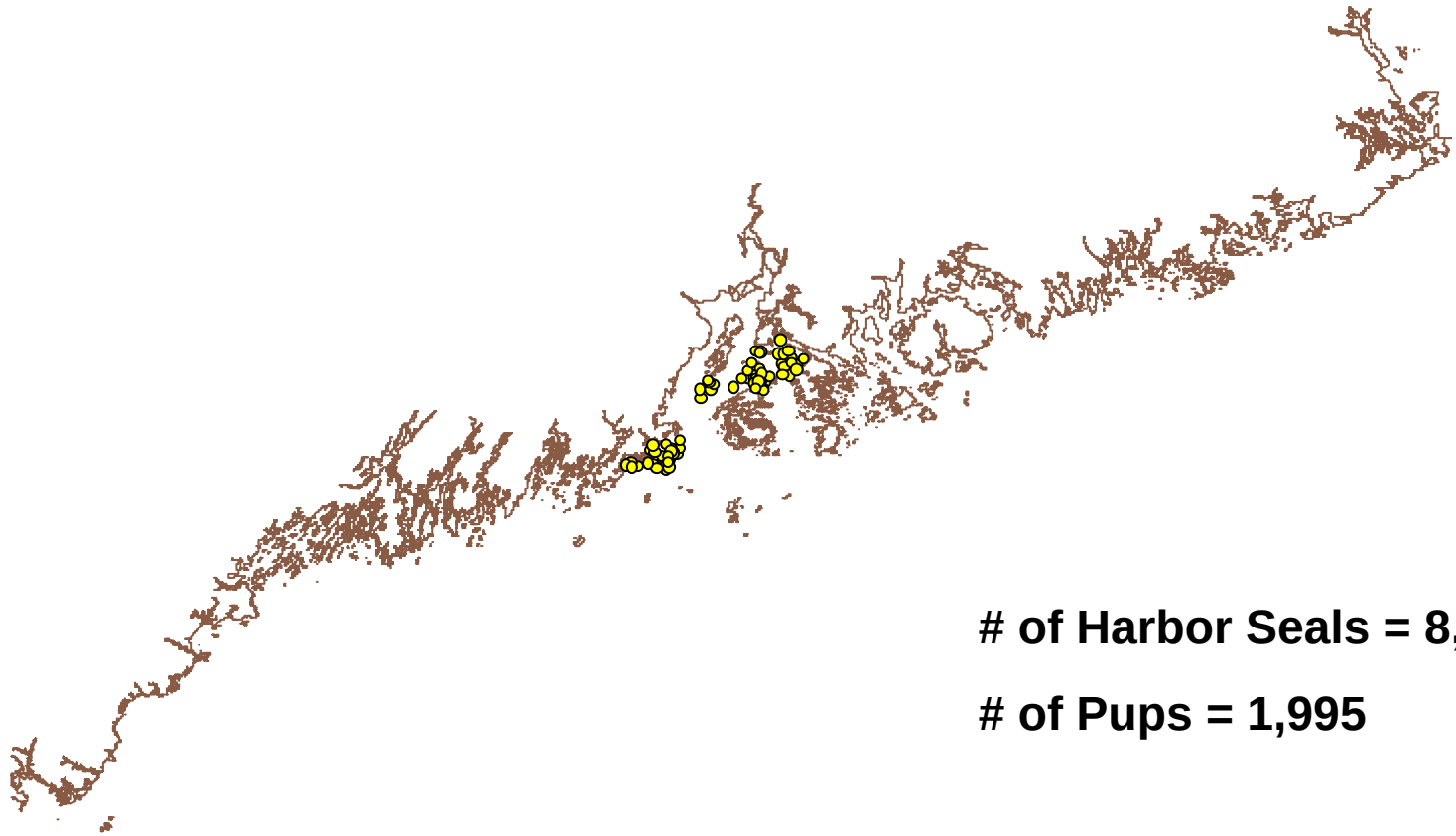
# of Gray Seals = 100

# of Ledges Used = 511

60 30 0 60 Miles

N
W E
S

Figure 10. 1997 Replicate Survey dates: June 9 and 10
Area Surveyed: Segments of Penobscot Bay



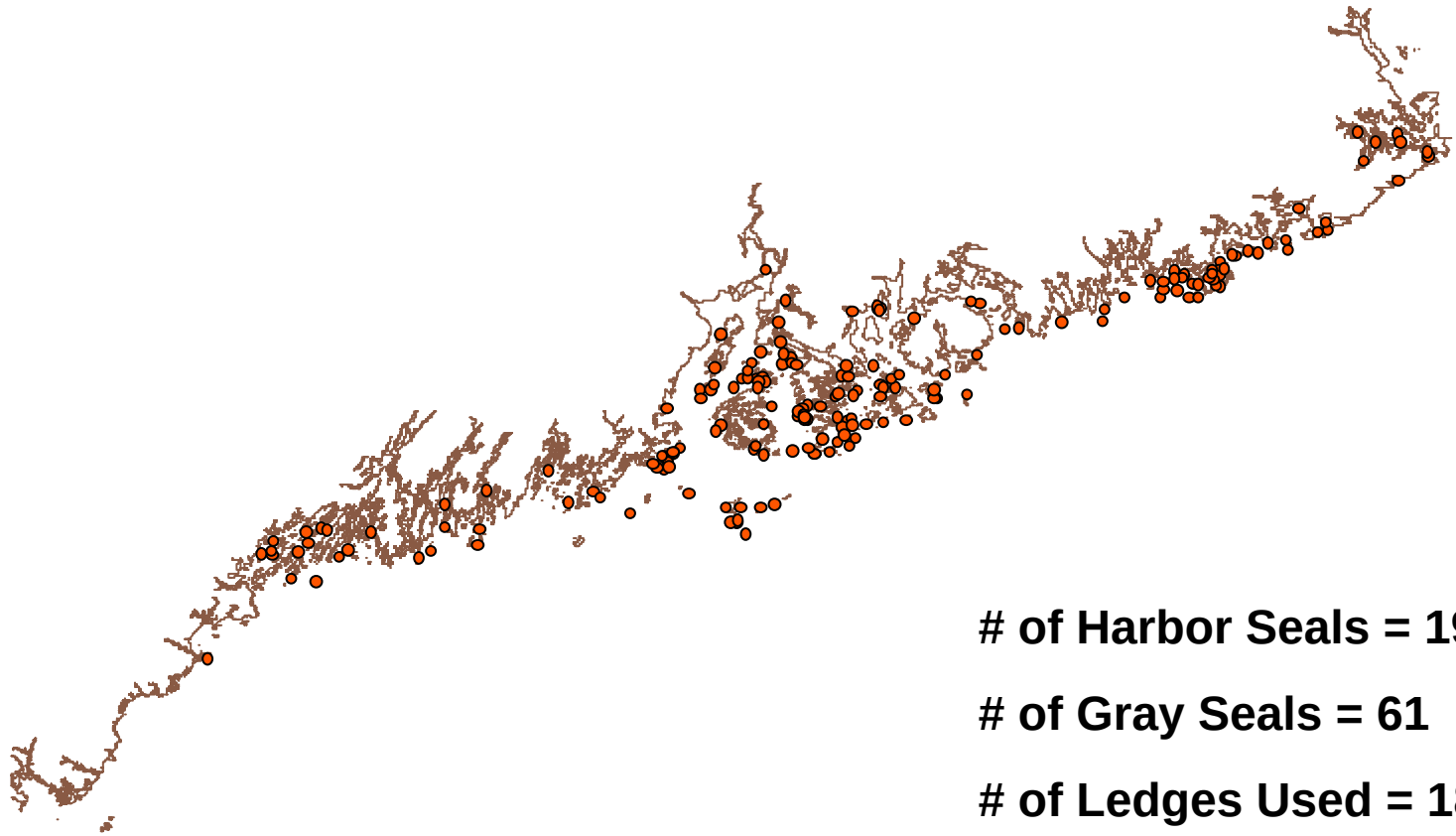
# of Harbor Seals = 8,909

# of Pups = 1,995

60 30 0 60 Miles

N
W E
S

Figure 11. 1997 Survey dates: August 9. 10. 12 and 14
Area Surveyed: All of Coastal Maine



# of Harbor Seals = 19,312

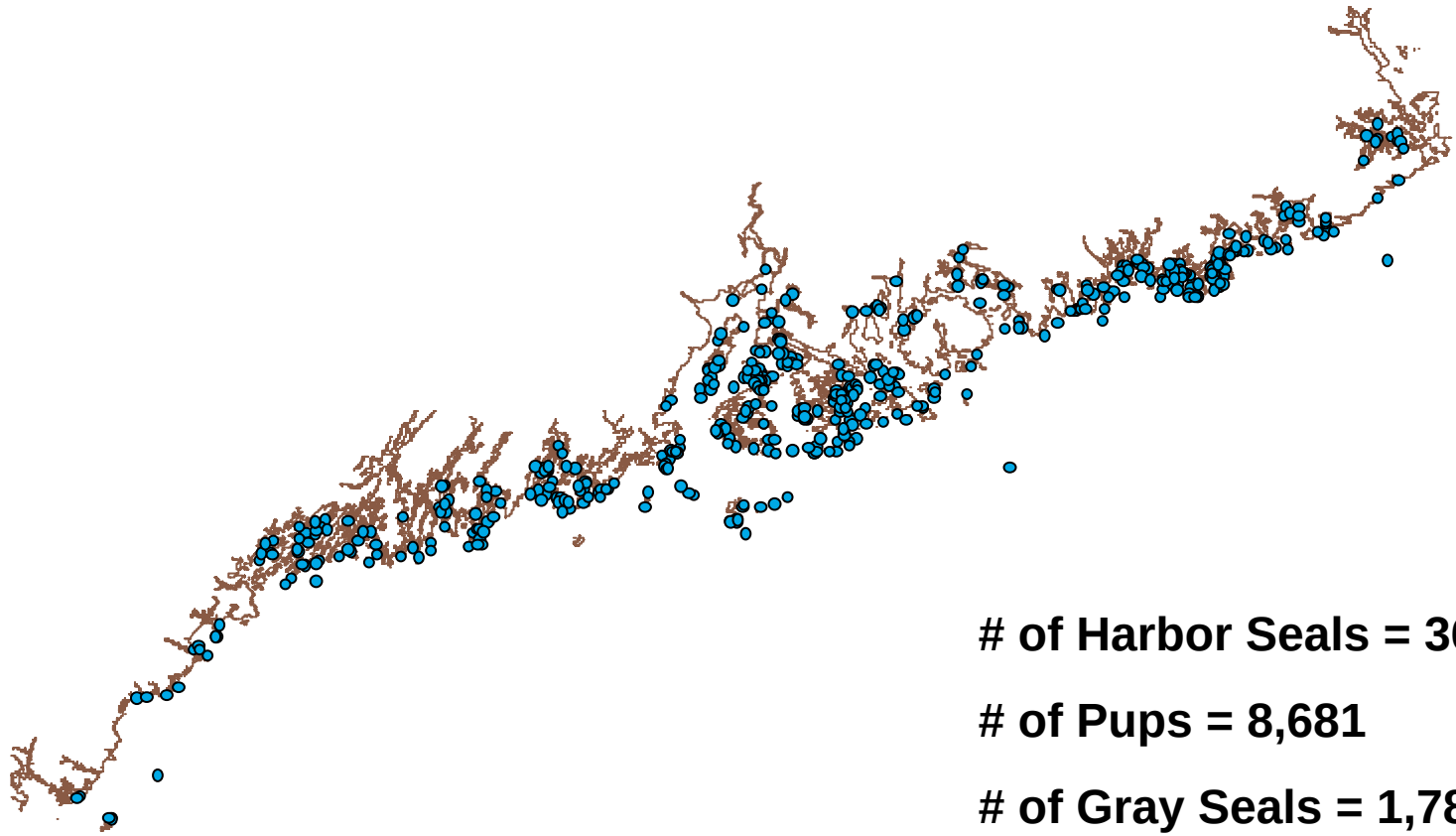
# of Gray Seals = 61

# of Ledges Used = 187

60 30 0 60 Miles

N
W E
S

Figure 12. 2001 Survey dates: May 27, 29, 30, 31 June 1 and 4
Area Surveyed: All of Coastal Maine and Isles of Shoals



# of Harbor Seals = 36,327

# of Pups = 8,681

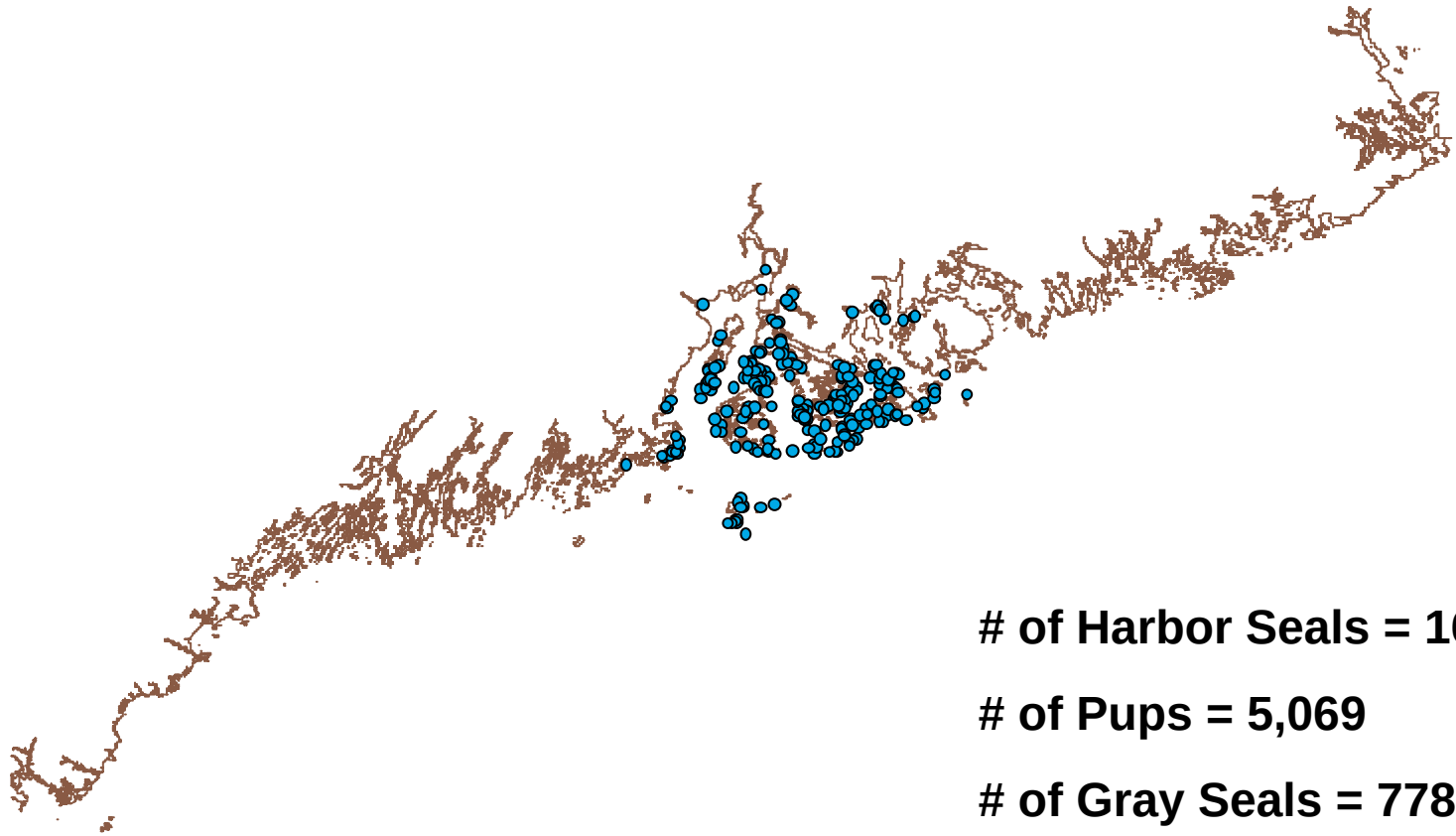
# of Gray Seals = 1,786

# of Ledges Used = 496

60 30 0 60 Miles

N
W E
S

Figure 13. 2001 Replicate Survey dates: May 27, 29, 30, 31 and June 1
Area Surveyed: Penobscot, Blue Hill and Cobscook Bays



# of Harbor Seals = 16,755.25

# of Pups = 5,069

# of Gray Seals = 778.5

60 30 0 60 Miles

N
W E
S