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Overview

1) Status update 2022
   • Occupied range
   • Implementation of integrated population model (IPM)

2) Miscellaneous updates

This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science. The information is provided on the condition that neither the U.S. Geological Survey nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the information.
Greater Yellowstone Ecosystem

National Parks = 10,344 km²
Primary Conservation Area/Recovery Zone = 23,828 km²
Demographic Monitoring Area (DMA) = 49,931 km²
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Demographic Monitoring Area (DMA) = 49,931 km²
Estimated Grizzly Bear Range = 70,101 km²
Greater Yellowstone Ecosystem

National Parks = 10,344 km$^2$
Primary Conservation Area/Recovery Zone = 23,828 km$^2$
Demographic Monitoring Area (DMA) = 49,931 km$^2$
Estimated Grizzly Bear Range = 70,101 km$^2$ with outliers
Demographic Recovery Criterion #1: Females with Cubs and Population Size
## Number of females with cubs 2022 (16-km distance criterion, inside DMA)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique females with cubs</td>
<td>57</td>
</tr>
<tr>
<td>Unique females with cubs (excluding telemetry observations)</td>
<td>49</td>
</tr>
<tr>
<td>Chao2 estimate</td>
<td>60</td>
</tr>
</tbody>
</table>
Integrated Population Models

- Started investigations in 2018
- Allows for a more unifying and flexible monitoring and management framework
- Fundamentally an extension of current monitoring
- Implementation with data through 2022
Bayesian statistics

\[ \hat{N}_t = \hat{N}_{t-1} + \text{Births} - \text{Deaths} \]

675 = 650 + 50 - 25

Mean/Median

95% Credible Interval
Population size 2022 (IPM, DMA)

<table>
<thead>
<tr>
<th>Population segment</th>
<th>Median estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent females (≥2 yrs)</td>
<td>328</td>
</tr>
<tr>
<td>Independent males (≥2 yrs)</td>
<td>332</td>
</tr>
<tr>
<td>Yearlings</td>
<td>98</td>
</tr>
<tr>
<td>Cubs born</td>
<td>200</td>
</tr>
</tbody>
</table>

Total estimate 2022* 965 (95% CI = 819–1121)

*Sum of segment medians slightly different from median of total estimate
Total population size (IPM, DMA)
Total population size (IPM, DMA)
Population growth (IPM, DMA)
Population size as a probability distribution (IPM, DMA)

Median = 965

95% credible interval = 819–1121
Population size as a probability distribution (IPM, DMA)

Density

N = 866

90% probability (upper interval)

Total Abundance

600 700 800 900 1000 1100 1200 1300

0.000 0.001 0.002 0.003 0.004 0.005
Demographic Recovery Criterion #2: Occupancy by Females with Young
Occupancy by females with young (cubs, yearlings, or 2-year-olds) 2022

- 18 of 18 Bear Management Units (BMUs) occupied during 2022

- 18 of 18 BMUs occupied at least 5 of last 6 years (2017-2022)
Demographic Recovery Criterion #3: Mortalities
## Known and probable mortalities by sex and age class 2022 (DMA)

<table>
<thead>
<tr>
<th>Area</th>
<th>Sex</th>
<th>Dependent (&lt;2 years old)</th>
<th>Independent (≥2 years old)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside DMA</td>
<td>Female</td>
<td>3</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>5</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>9</td>
<td>20</td>
<td>29</td>
</tr>
</tbody>
</table>
## Known and probable mortalities by sex and age class 2022 (outside DMA)

<table>
<thead>
<tr>
<th>Area</th>
<th>Sex</th>
<th>Age class</th>
<th>Dependent (&lt;2 years old)</th>
<th>Independent (≥2 years old)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside DMA</td>
<td>Female</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>4</td>
<td>9</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>5</td>
<td>12</td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>
Mortalities inside/outside DMA by cause 2022

- Natural
- Site conflicts
- Self-defense
- Illegal
- Mistaken ID
- Livestock
- Accidents
- Humane removal
- Undetermined

Count

Inside DMA

Outside DMA

IGBST
Preliminary Information-Subject to Revision. Not for Citation or Distribution.
Cumulative documented mortalities by week 2009-2022 (GYE)
Miscellaneous Updates

Photo: J. Hadley/USGS
Body composition, density, and changing foods

Source: Corradini et al. (2023 [in press])
Estimating body condition (% body fat)
Lean body mass

Male: $W_t = 161.51 \left(1 - e^{-0.21(t - 0.54)}\right)$

Female: $W_t = 94.77 \left(1 - e^{-0.39(t - 0.44)}\right)$

Source: Corradini et al. (2023 [in press])
Seasonal body fat gain (2000s vs. 2010s)

Source: Corradini et al. (2023 [in press])
Genetic monitoring

• Results for 1983-2020
• 1,331 individuals genotyped (20 microsatellite markers)
• No evidence of non-GYE ancestry in any of the individuals genotyped to date

Photos: IGBST
Grizzly bear occupied range NCDE, CYE/SE, and GYE

55 km (35 miles)
Management capture and removal for cattle depredation 5/12/2021

Preliminary Information- Subject to Revision. Not for Citation or Distribution.
Management capture and removal for cattle depredation 5/12/2021

2 closely related individuals
Study Team website: search “IGBST”

Annual/Technical reports:
IGBC website (IGBConline.org)

Photo: J. Hadley/USGS (remote camera)
Acknowledgments 2022

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