Occupancy Modeling of Ridgway’s Rail in Topock Gorge

Chris Dodge
Wildlife Biologist
US Bureau of Reclamation
Introduction

• The LCR MSCP is tasked with creating 512 acres of marsh habitat.
• Currently the LCR MSCP has created several sites with marsh habitat (Hart Mine Marsh, Laguna Division Conservation Area, Field 18 at Imperial Ponds Conservation Area)
• The LCR MSCP is currently maintaining water depths at 0-12 inches for Ridgway’s Rail (Yuma clapper rail).
• Given the water fluctuations seen on the river does the LCR MSCP need to maintain such strict water depths?
Background

• (Edelman 1989) from 1985-87 research was conducted at two sites on the LCR.
  – At Crystal Beach on the south end of Topock Gorge water fluctuations were reported of 1.1 meters (3.6 feet).
  – Rails are able to persist even with variation in water levels if the marsh vegetation remains undisturbed, water is consistently present, substrate depth varies gradually, and slightly higher sites or upland are close by.
  – Gradual change was surmised to be important.
Several authors have stated that birds were adapted to highly variable water levels in pre-dam conditions on the LCR (Conway 1993, Sykes 1937, Ohmart et al. 1975).

At Field 18 at Imperial Ponds Conservation Area, Ridgway’s Rail were found to prefer depths of 0 to 65 mm (0-3”) but this low value was seen as likely due to a lack of deeper water with vegetation in the study area. Rail numbers were highest in the year with the greatest variation in water depths. (Nadeau et al. 2011)

Ridgway’s Rail may be able to respond to high flood levels by adapting their nests.

In San Francisco only severe tidal flooding of over 2 meters posed a threat to nesting birds (Schwarzbach et al. 2006)
Topock Gorge

• There is one gauge in Topock Gorge at the north end

• Water levels were collected from 2006 to 2014.

• There are 52 survey points
Topock Gorge Water Levels

• Data was analyzed per marsh bird survey period starting on March 1 to late March, late March to mid-April, and mid-April to mid-May.

• In order to determine water fluctuation, we took the daily average and subtracted the minimum value from the maximum value for each period.

• The smallest fluctuation was 1.36 feet in the second period of 2014 and the largest fluctuation was 5.36 feet recorded for the first period of 2010.
Topock Gorge Water Fluctuations

![Graph showing water level fluctuations over years](image)
Marsh Bird Abundance

• We cannot make assumptions about abundance based on the number of detections of secretive marsh birds using the standard protocol

• It is not an appropriate use of the data to compare sites or different years of the same site using just the number of detections.

• We need detection probability.
Occupancy Modeling

• Data from marsh bird surveys were modeled using Occupancy Modeling techniques in Program Presence (Version 9.0) to determine whether presence of clapper rails was influenced by observed water level fluctuations in each survey period.
• Data on the number of detections was transformed so that only a detection or non-detection of a clapper rail was recorded for each survey point.
• The per-period water fluctuation values were used as an environmental covariate.
Ridgway’s Rail Presence per Year
Occupancy Modeling

• Four probabilities are calculated
  – Psi = The probability of a site being occupied.
  – Gamma = Colonization, or the probability that a site unoccupied in one year is then occupied in a subsequent year.
  – Epsilon (EPS) = Extinction, or the probability that a site that is occupied in one year is then unoccupied in a subsequent year.
  – P = Detection probability.

• Covariates can be added and Akiake’s Information Criterion (AIC) is used to compare models.
## Modeling Results (no correction for small sample size)

The top 3 models do not have the fluctuation co-variate.

<table>
<thead>
<tr>
<th>Model</th>
<th>AIC</th>
<th>deltaAIC</th>
<th>AIC wgt</th>
<th>Model Likelihood</th>
<th>no.Par.</th>
<th>-2*LogLike</th>
</tr>
</thead>
<tbody>
<tr>
<td>psi(),eps(),p(Period*yr)</td>
<td>1600.3</td>
<td>0</td>
<td>0.3055</td>
<td>1</td>
<td>29</td>
<td>1542.3</td>
</tr>
<tr>
<td>psi(),gamma(),p(Period*yr)</td>
<td>1600.3</td>
<td>0</td>
<td>0.3055</td>
<td>1</td>
<td>29</td>
<td>1542.3</td>
</tr>
<tr>
<td>psi(),gamma(),eps(),p(Period*yr)</td>
<td>1602.26</td>
<td>1.96</td>
<td>0.1147</td>
<td>0.3753</td>
<td>30</td>
<td>1542.26</td>
</tr>
<tr>
<td>psi(Fluc_season),gamma(),p(Period*yr)</td>
<td>1602.28</td>
<td>1.98</td>
<td>0.1135</td>
<td>0.3716</td>
<td>30</td>
<td>1542.28</td>
</tr>
<tr>
<td>psi(Fluc_season),gamma(Fluc_season),p(Period*yr)</td>
<td>1603.2</td>
<td>2.9</td>
<td>0.0717</td>
<td>0.2346</td>
<td>31</td>
<td>1541.2</td>
</tr>
<tr>
<td>psi(Fluc_season),eps(),p(Period*yr)</td>
<td>1603.42</td>
<td>3.12</td>
<td>0.0642</td>
<td>0.2101</td>
<td>30</td>
<td>1543.42</td>
</tr>
<tr>
<td>psi(Fluc_season),eps(Fluc_season),p(Period*yr)</td>
<td>1605.33</td>
<td>5.03</td>
<td>0.0247</td>
<td>0.0809</td>
<td>31</td>
<td>1543.33</td>
</tr>
</tbody>
</table>
### Results for each Hypotheses

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Summed Model Weights</th>
<th>Evidence Ratio*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluctuation on Occupancy</td>
<td>0.2742</td>
<td>0.378</td>
</tr>
<tr>
<td>Fluctuation on Colonization</td>
<td>0.0717</td>
<td>0.077</td>
</tr>
<tr>
<td>Fluctuation on Extinction</td>
<td>0.0247</td>
<td>0.025</td>
</tr>
<tr>
<td>Period+year on detection</td>
<td>0.9999</td>
<td>9999.000</td>
</tr>
</tbody>
</table>

* Evidence Ratio = SMW/(1-SMW)
Detection Probabilities by Year and Period With 95% CI
Conclusions

• Based on this data and method, there is no evidence that the levels of water fluctuations seen at Topock Gorge are having an effect on the presence of Ridgway’s Rail during the breeding season.
• Detection probabilities vary by year and by each survey period.
• When possible, conducting 3 surveys per year allows for a more robust analysis of the data.
• This project deals with the fluctuations in water levels within a large system and does not address the actual depths of water found at nests.
Going forward...

• Publish progress report to LCR MSCP website

• Add the data from Topock Marsh to the analysis

• Include data from 2015 and possibly 2016

• Start to look at the California Black Rail literature
Literature Cited