Waterbird negative examples

Birds that the boats pass are called “positives”, birds that pass the boats are called “negatives”.

Our assumption about where negatives land influences how we calculate the number of birds to assign to each section. All positives are assigned to the section in which they were first encountered, even if they subsequently become negatives. So, any negatives have already been assigned to a section, and they should not be counted again if they are reencountered. However, no new positives can be added until the pool of known birds ahead of the boats has been used up. No negatives should be added backward until the pool of known birds behind the boats is used up.

We assume all negatives originated on the bay. Some negatives likely stop in the current section after they fly passed the boats, while some continue to farther north sections, and some may leave the bay. If they land in the current section, then they will become positives again, in which case we would want to avoid double adding them again to the current section. On the other hand, if they continue to subsequent sections (or leave the bay), then we want to continue adding positives in the current section. However, we don’t have a way to know where negatives land, so we must make some assumptions to apply consistently to all negatives.

If we assume that negatives land in the current section, then the number of birds to assign to the current section is positives - negatives. If we use this method, any positives in future sections are new, have not been assigned to a section yet and should be assigned where they are a=observed again. However, this method seems to underestimate the number of birds in a section as the number of negatives passes the number of positives \* 0.5. Once negatives > 0.5\*positives, we must assume that the same birds are flying forward multiple times but remaining in the current section to be counted again.

If we assume that negatives land in subsequent sections, then the number of birds to assign to the current section is all the positives. If we use this method, and we assume that all negatives come from the positives in the same section, then we have already assigned all the negatives to the current section, and we must not assign any birds to subsequent sections until this “pool” of negatives is used up. This method requires we tally the negatives and positives separately, which will involve going back to enter some raw data for the historic surveys.

It can be challenging to visualize all these positives and negatives, so on the following pages are some worked examples showing this negative method on data we’ve already collected. These examples use data for which the total positives and negatives for each block have been tallied separately.

| 2009-02-08 BRAC | Raw data | |  | Cumulative | | |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Section | Net positive | Net Negative |  | Known behind | Known ahead | Add backward (add to section 1 draft) | Draft section value |
| 1 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| 2 | 4,881 | -9,732 |  | 0 | -9,732 | 4,851 | 4,881 |
| 3 | 41 | -57 |  | 0 | -9,748 | 4,867 | 0 |
| 4 | 9 | -25 |  | 0 | -9,764 | 4,883 | 0 |
|  | | | | | | | Bay total = 9764 |

For BRAC on 2/8/2009, in section 1, we encountered no BRAC.

In section 2, there were 4881 positives and 9732 negatives. We assume that all 4881 positives were among the 9732 negatives, so there are 0 known birds behind the boats at the end of section 2. Since there were no known birds ahead of the boats at the end of section 1 (which might have landed in section 2), all positive 4881 should be assigned to section 2. Since we encountered more negatives than positives in section 2, and there were no known birds behind the boats, we need to add 9732 - 4881 = 4851 birds back to section 1.

In section 3, there were 41 positives and 57 negatives. We assume that the 41 positives were some of the 9732 that flew forward in section 2 (and were assigned to sections 1 or 2), so we do not assign them to section 3. Also because of that assumption, there are now 9748 (absolute value of -9732 + 41 - 57) known birds ahead of the boats, and still 0 known birds behind the boats. Because there were 0 known birds behind the boats at the start of section 3, there were 16 (absolute value of 47 - 57) newly encountered birds in section 3 that need to be added back, so the new add back value is 4851 + 16 = 4867.

In section 4, the boats passed 9 birds and 25 passed the boats. Similar to section 3, because there are still 0 known birds behind the boats the main result is that we have another 16 (abs. val. of 9 - 25) newly encountered birds, and the new add backward value is 4867 + 16 = 4883.

This yields a total of 9764 BRAC on the entire bay.

The old negative machine assigned 0 BRAC to section 1, 2954 to section 2, 0 to section 3, and 4884 (all carried forward negatives) to section 4 for a total of 7838 BRAC on the entire bay. Thus the total number of BRAC on the bay and the spatial distribution are quite different. It seems that because the old method does not add negatives when they are first encountered, then later removes them when more positives are encountered, some of these birds end up getting missed from the total tally. This seems to happen when there are is a large net negative value early in the survey and few subsequent positives.

| 2019-01-12 DCCO | Raw data | |  | Cumulative | | |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Section | Net positive | Net Negative |  | Known behind | Known ahead | Add backward (add to section 1 draft) | Draft section value |
| 1 | 1,209 | -3 |  | 1,206 | -3 | 0 | 1,209 |
| 2 | 1,353 | -538 |  | 2,021 | -538 | 0 | 1,350 |
| 3 | 122 | -7 |  | 2,136 | -423 | 0 | 0 |
| 4 | 7 | -1 |  | 2,142 | -417 | 0 | 0 |
|  | | | | | | | Bay total = 2559 |

For DCCO on 1/12/19, in section 1 there were 1209 positives and 3 negatives. We assume that all 3 negatives were among the 1209 positives, so we end the section with 1209 - 3 = 1206 known birds behind the boats and 3 known birds ahead of the boats. There are no birds to add backward, and all 1209 positives are assigned to section 1.

In section 2 there were 1353 positives and 538 negatives. there are now 1206 + 1353 - 538 = 2021 known birds behind the boats. Because -3 + 1353 > 0, there are now 0 + 538 known birds ahead of the boats (i.e., 538 of the 1353 positives subsequently became negatives).

In the old negative machine for DCCO on Jan 1 2019, the old negative machine assigned 1212 DCCO to section 1, 261 to section 2, 117 to section 3, and 764 to section 4 for a total of 2354 DCCO on the entire bay. The old negative machine ends up with substantially more DCCO on the bay than the new method; the old method apparently assumes that the -1136 observed in section 2 were not the same birds as the positive 1212 observed in section 1 subsequently flying forward, and instead assumes they are totally new birds to carry forward for possible addition to section 4.

| 2013-02-09 BRAC | Raw data | |  | Cumulative | | |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Section | Net positive | Net Negative |  | Known behind | Known ahead | Add backward (add to section 1 draft) | Draft section value |
| 1 | 2 | 0 |  | 2 | 0 | 0 | 2 |
| 2 | 690 | -479 |  | 213 | -479 | 0 | 690 |
| 3 | 6 | -157 |  | 62 | -630 | 0 | 0 |
| 4 | 0 | -161 |  | 0 | -791 | 99 | 0 |
|  | | | | | | | Bay total = 791 |

For BRAC on Feb 9 2013, in section 1 the boats passed 2 birds and 0 birds passed the boats. We assign those 2 birds to section 1.

In section 2, there were 690 positives and 479 negatives. Since 0 birds flew ahead in section 1, all 690 birds are newly encountered, so all are assigned to section 2. We assume all 479 negatives came from these 690 section 2 positives. We now have 2 + 690 - 479 = 213 known birds behind the boats and 479 known birds ahead of the boats.

In section 3 there were 6 positives and 157 negatives. We assume 6 of those negatives, came from the section 3 positives, so there are now 213 + 6 - 157 = 62 known birds behind the boats. We assume those 6 positives were among the -479 known ahead at the end of section 2, so we now have -479 + 6 - 157 = -630 known birds ahead of the boats. Since all 6 of those were already encountered and assigned in section 2, they are not assigned to section 3.

In section 4 there are 0 positives and 161 negatives. 62 of those negative came from the 62 known birds behind the boats, but the remaining cannot be explained by previously encountered birds and we assume they were missed somewhere earlier in the survey (likely between the precounts and the start of section 1). Thus we need to add absolute value of (62 - 161) = 99 back to section 1. There are no birds to assign to section 4.

This gives a total of 2 + 99 + 690 = 791 birds on the entire bay.

| 2015-02-14 BRAC | Raw data | |  | Cumulative | | |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Section | Net positive | Net Negative |  | Known behind | Known ahead | Add backward (add to section 1 draft) | Draft section value |
| 1 | 8 | -1 |  | 7 | -1 | 0 | 8 |
| 2 | 3,742 | -408 |  | 3,341 | -408 | 0 | 3,741 |
| 3 | -30 | -540 |  | 2,771 | -978 | 0 | 0 |
| 4 | -602 | -565 |  | 1,604 | -2,145 | 0 | 0 |
|  | | | | | | | Bay total = 3749 |

For BRAC on 2/14/2015, in section 1, the boats passed 0 birds and 1 bird passed the boats. There are no known birds behind the boats, and 1 known bird ahead of the boats. That 1 ahead of the boats needs to be added back to section 1, but we wait to do that operation until the end. Thus the draft number of BRAC in section 1 is 0.

In section 2, there were 3742 positives and 408 negatives. We assume that all of the 408 negatives were among the 3742 positives. We also assume that the 1 bird ahead of the boats at the start of section 2 was among the 3742, so that bird is removed from the cumulative known ahead tally. So, there are now 3742 - 408 = 3334 known birds behind the boats and 1 -1 + 408 = 408 birds ahead of the boats. Because we assume that one of the 3742 that the boats passed was the bird that flew ahead in section 1 (which we have already assigned to be added back to section 1), we have encountered 3742 - 1 = 3741 new birds in section 2, so that is the draft section 2 value.

In section 3, there were 0 positives and 240 negatives. We assume that all 240 of those negatives came from the pool of 3334 known to be behind the boats at the start of section 3. So, because we didn’t pass any birds we now have 0 + 3334 - 240 = 3094 known birds behind the boats. We also now have 408 + 240 = 648 known birds ahead of the boats. There are 0 newly encountered birds in section 3, so the draft section 3 value is 0, and the number to add backward to section 1 remains at 1.

In section 4, there were 42 positives and 565 negatives. We assume the -565 were from the large pool of known birds behind the boats (3094) that have already been assigned to a previous section, so we now have 3094 - 565 = 2571 known birds behind the boats, 648 + 565 = 1171 birds ahead of the boats, and we assign 0 birds to section 4.

That leaves us with a total of 3742 BRAC on the entire bay.

The old negative machine for BRAC on Feb 14 2015 assigned 8 to section 1, 3538 to section 2, 3 to section 3, and 0 to section 4 for a total of 3549 on the entire bay. Here, both the baywide total and the spatial distribution are similar between the 2 methods.

| 2011-12-17 DCCO | Raw data | |  | Cumulative | | |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Section | Net positive | Net Negative |  | Known behind | Known ahead | Add backward (add to section 1 draft) | Draft section value |
| 1 | 5 | -560 |  | 0 | -560 | 555 | 5 |
| 2 | 316 | -636 |  | 0 | -880 | 875 | 0 |
| 3 | 35 | -3 |  | 32 | -848 | 875 | 0 |
| 4 | 9 | 0 |  | 41 | -839 | 875 | 0 |
|  | | | | | | | Bay total = 880 |