Osprey candidacy for inclusion in the NWACS ecosystem models: a review of population and diet

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Osprey candidacy for inclusion in the NWACS ecosystem models: a review of population and diet

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In the previous version of the NWACS-Full ecosystem model (SEADR, 2020), the functional group "nearshore piscivorous birds" was included to incorporate the predation effects of piscivorous birds like osprey (*Pandion haliaetus*), bald eagles (*Haliaeetus leucocephalus*), cormorants *(Nannopterum auritum)*, and similar species that feed close to shore, as distinct from seabirds like gulls *(Larus* spp.), shearwaters (*Puffinus* spp.), and other species that can feed far out on the coastal shelf. In the 2020 version of the NWACS-Full model, the data available on this group was limited to the available literature, much of which was outside of the model area or only included a very small sample of each explored species. As there is a growing interest in the effects of menhaden populations on nearshore birds, the ERP workgroup wanted to explore if there were more available population and diet data on nearshore piscivorous birds to update this category in this iteration of the model. During the preliminary search, it became apparent that the most robust data available for this group were largely for osprey. Based on this, the NWACS-Full model's avian functional group was split into "osprey" and "other nearshore piscivorous birds." Outlined in this working paper are the exact methods used to construct the osprey abundance and biomass time series and diet composition.

Abundance and biomass time series

The USGS Breeding Bird Survey (BBS; Hostetler et al., 2023) data consists of population trend estimates for over 500 bird species. These estimates are derived from the BBS, where 2,500 community scientists record bird sightings along 4,800 pre-determined roadside survey routes in the U.S. (Eastern Ecological Science Center, 2022). These data, although limited or absent for other nearshore piscivorous birds, had population trends available for osprey near and within the model domain. The data were filtered to the geographic strata of S14 (Maine and a portion of Southern New England) and S30 (Southern New England to Virginia; Figure 1) to obtain osprey indices of abundance within the model area from 1966 to 2022. Note that although the BBS had data from southeastern Virgina (south of the Chesapeake Bay) to North Carolina within the S27 stratum, these data were not included because they were aggregated with data from the Gulf without any way to separate them. In addition to the index of abundance, to obtain a point estimate of the population for S14 and S30, the Partners In Flight (PIF) Population Estimates Database data set was used (Partners In Flight, 2020). PIF estimates are based on aggregate survey data which are derived from weighting the effectiveness, size, and monitoring length of individual monitoring routes from 2006 to 2015 (Stanton et al., 2019). This provides a sole number of estimated birds over a 10-year period per region (one number for S14 and one for 27). As these point-estimates cannot be disaggregated, they were centered on 2011 as the midpoint of annual range and then extrapolated out using the BBS index of abundance to obtain an abundance time series for both regions (Figure 2).

For biomass, an estimated weight of 1.68 kg (Candler & Kennedy, 2004) was used as the average weight of an adult osprey and multiplied through the time series (Figure 3).

When these time series were used to inform the NWACS-FULL model's "osprey" functional group, the total population size of osprey from the S14 and S27 regions were assumed to reside within the model domain. Data were not partitioned in any way to account for the geographic differences between the Bird Conservation Regions that inform BBS data collection (Figure 1) and the model domain because the BBS dataset (Hostetler et al., 2023) only provides indices within these two regions without any way to further disaggregate the data.

Diet data

For diet composition, a literature review in Google Scholar showed that most papers from 1970 to 2024 focused on diet data for osprey outside of the model area. However, 12 papers provided diet estimates for the eastern U.S. that fell in or slightly outside (Nova Scotia to Florida) the model area.

The 12 papers reviewed for diet composition were broken into individual sites and sample size (*n*) was considered the number of nests (Table 1). A weighted average was derived for each percent of prey group consumed based on site and *n*, with a greater sample size having a higher weighting. Two of the papers (Glass & Watts, 2009; McLean & Byrd, 1991) had prey consumption percentage estimates by biomass and the rest had estimates by number. The papers with estimates by biomass were given double the weight of papers that had estimate by number as biomass is seen to be a more accurate representation of a predator's overall diet. Some of the papers reported consumption of freshwater fish, which were separated out as their own prey group for this predator.

These weighted averages were then used in the NWACS-Full model's diet data matrix for the "osprey" functional group.

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Table 1. Preliminary review of diet studies that include osprey diets. The diets from each source were broken into prey groups of the NWACS-Full model and the numbers represents percent diet composition of each prey found in the osprey diet. Note that only species that fall into the functional group categories are included. n = number of osprey nests *indicate studies outside the model area but are close enough that they were included due to lack of diet information in the region. †indicate studies that had higher weight due to reporting diet composition in biomass rather than in number of individuals. The percentages in these rows indicate percent biomass. The percentages in non-marked rows indicate percent of individuals.

Paper	Site	n	Alt. Herring	Alosines	Menhaden	Butterfish	Small Pelagic - Other	Bluefish	Striped Bass	Weakfish	Croaker	Winter Flounder	Summer Flounder	Demersal Benthivorous Other	Demersal Piscivorous Other	Demersal Omnivorous Other	Medium Pelagic - Other	Freshwater
Edwards 1989	Newnan's Lake, FL*	22					34.1		18.8									47.9
Glass & Watts 2009†	Lower Chesapeake Bay	10	1.0		44.7		15.4	0.2	4.4		5.5		2.0	1.0		18.1		
	Upper Chesapeake Bay	16		0.4	4.5		53.3		1.8		3.9		<0.1	4.6		33.0	0.2	
Greene 1987	Nova Scotia*	11		29.0			19.0					32			21			
Jamieson et al. 1982	Nova Scotia*	3		22.2								57.7		13.3		6.7		
Lazarus et al. 2016	Poplar Island	12			44.3				47.8		2.5					6.7		2.0
	Susquehanna River	10					43.6											56.4
	Anacostia/ Potomac	13			4.3		31.9				2.1				2.13			57.0
	James River	13		1.0			19.8											80.9
McClean & Byrd 1991†	Lower Chesapeake Bay	7			74.7	0.4	0.4				3.9		1.7	12.4	0.1	6.1		<0.1
Nesbitt 1974	Newnan's Lake, FL*	1					26.3											26.3
Poole 1985	Westport River, MA	114		40.0								55.0						
Prévost 1977	Nova Scotia*	11		6.8								9.6		13.0		70.1		
Rattner et al. 2018	Coastal Inland Bay DE	9		2.11	72.1		0.5	1.1	2.1		3.7		14.7	3.7				
	Central DE Bay	9		1.67	50.0		15.0		1.7					26.7				5.0
	North DE River	9		<0.1	15.3		25.4	1.7		1.7				44.1		10.2		1.7
Rettew 2006	Martha's Vineyard	27	15.2	15.1 5.0				18	5.7				6.1	31.5				
Szaro 1978	Seahorse Key, FL*	6					27.0								2.0	72.0		

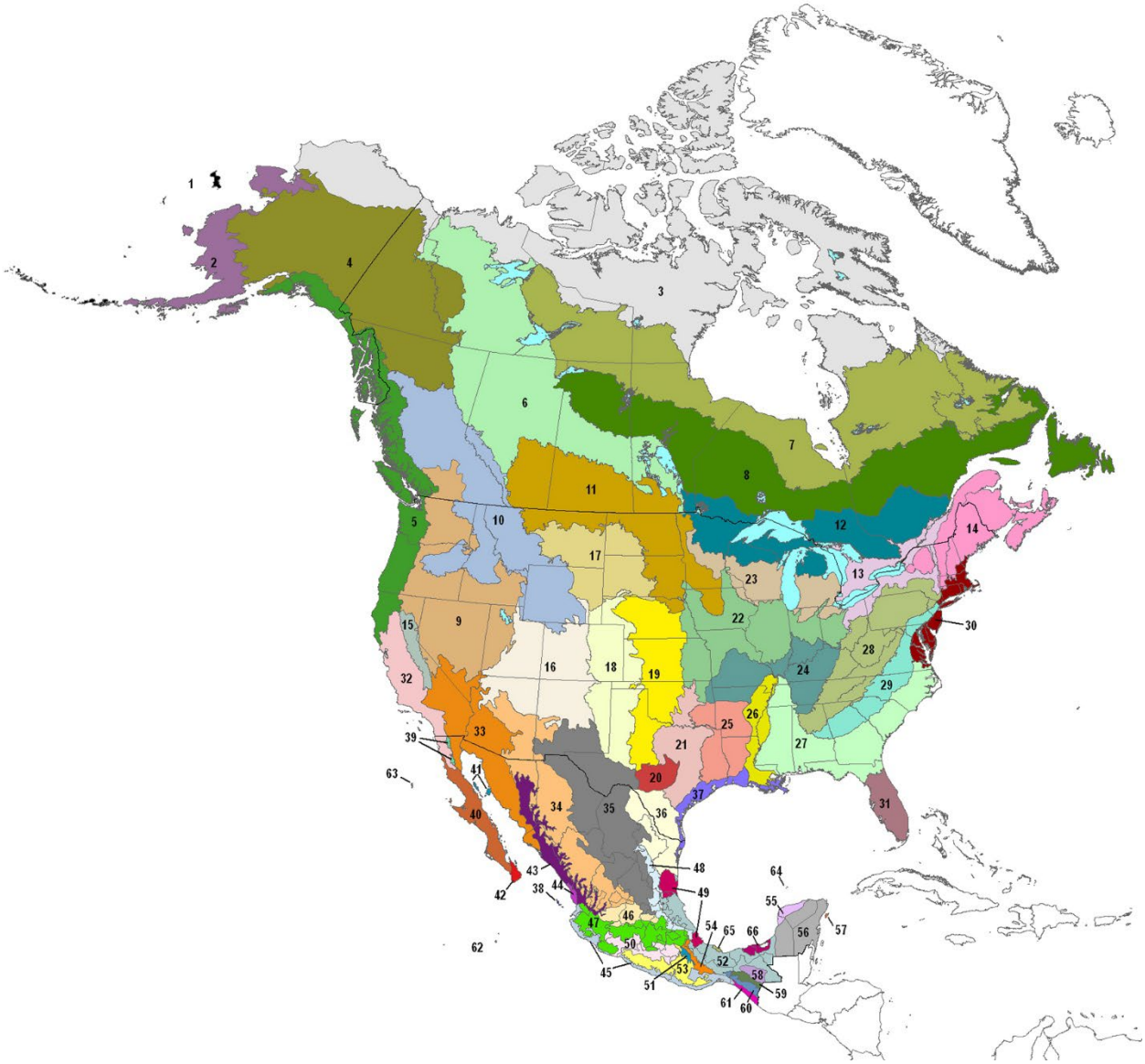

Figure 1. These are Bird Conservation Regions as published by Bird Studies Canada and the North American Bird Conservation Initiative (2014). These are the regions on which the BBS is based. Indices of abundance were derived from strata 14 (S14) and strata 30 (S30).

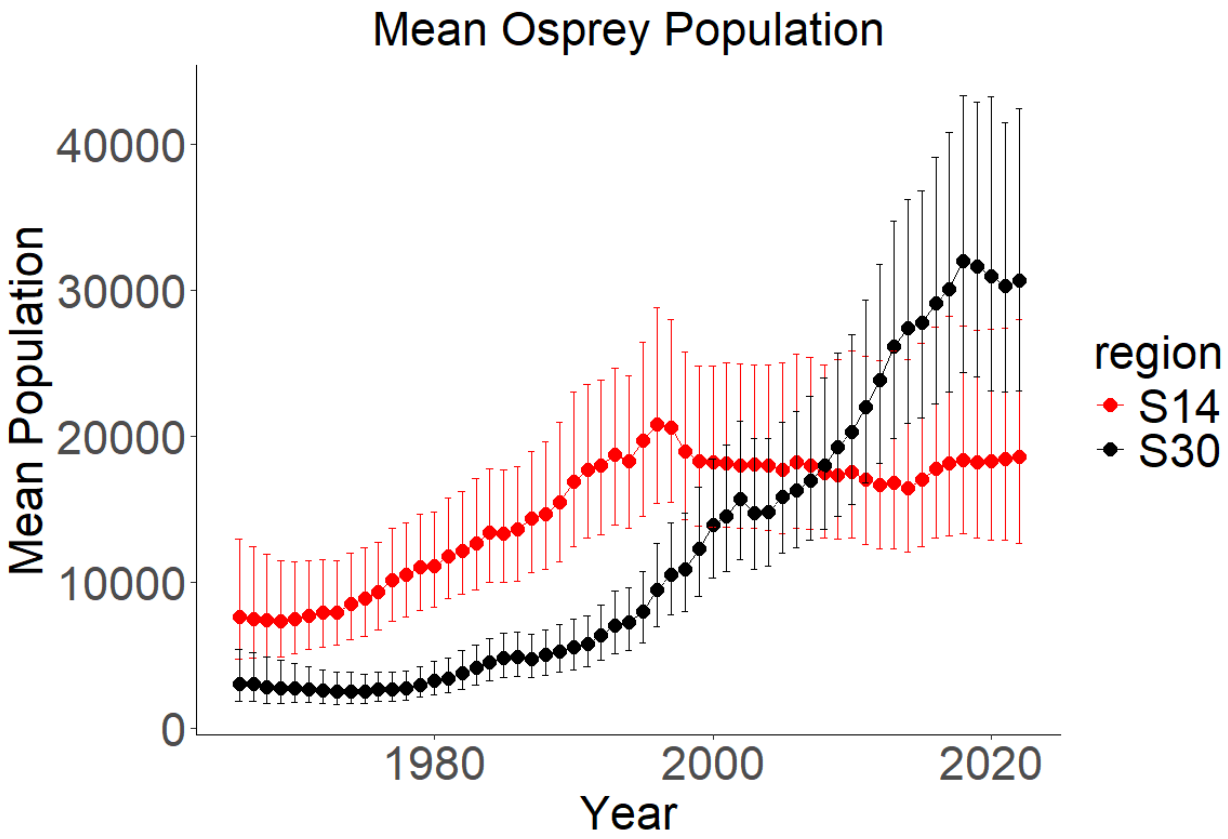

Figure 2. Time series of osprey abundance based on the index of abundance from the BBS data set and the point estimate from the PIF data set. S14 is Maine and S30 is the region from Southern New England to southern Virginia. The bars represent standard error.

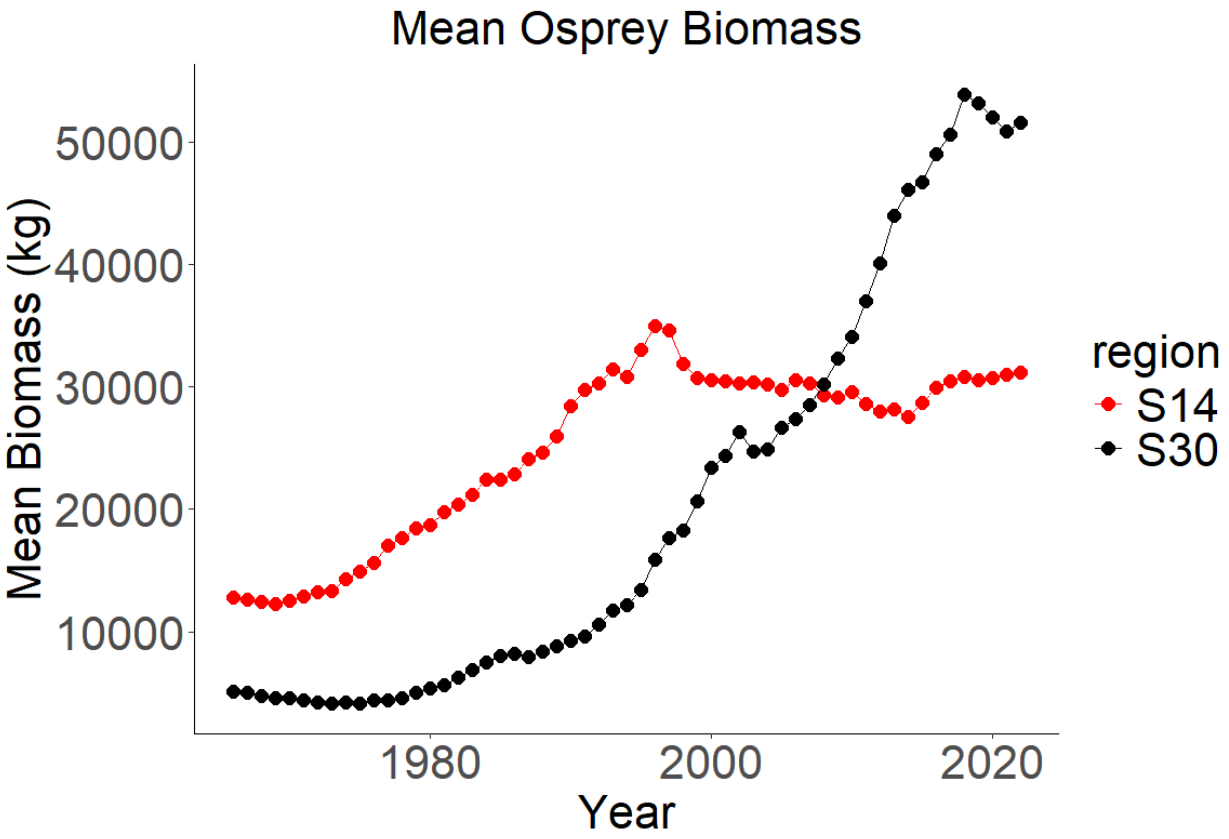

Figure 3. Time series of osprey biomass extrapolated from Figure 2 and the average weight of an osprey (Candler & Kennedy 2004). S14 is Maine and S30 is the region from Southern New England to southern Virginia.