

## 3.8. Maryland and Delaware Coastal Bays

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Species and habitats along in the back-barrier bays of Maryland and Delaware (hereafter referred to collectively as the Coastal Bays) are potentially at risk because of sea level rise. The Maryland Coastal Bays include Chincoteague, Sinepuxent, Newport, Isle of Wight, and Assawoman bays. The Delaware Inland Bays are three interconnected bays (Little Assawoman Bay, Indian River Bay, and Rehoboth Bay). The shorelines of the Coastal Bays contain important habitats for a variety of fish, shellfish, and birds, and a great deal is known about their ecology and habitat needs. Based on existing literature and the knowledge of local scientists, this brief literature review discusses the coastal species in the region that could be at risk because of further habitat loss resulting from sea level rise (see Section 3.1, Overview) and shoreline protection (see Map 3.7). Although it is possible to make qualitative statements about the possible impacts if sea level rise causes a total loss of habitat, our ability to discern what the impact might be if only a portion of the habitat is lost is more limited. A total loss of habitat is possible if shores are protected with hard structures and the wetlands are unable to keep pace with sea level rise.

### Back-Barrier Salt Marshes

There are an estimated 6,718 ha (16,600 acres) of salt marsh along Maryland's Coastal Bays, mostly along the mainland shorelines of Sinepuxent, Newport, and Chincoteague bays; there are about 1,012 ha (2,500 acres) of salt marsh in the northern bays.<sup>435</sup> There are an

estimated 5,510 ha (13,600 acres) of vegetated estuarine wetlands in the Delaware Inland Bays, most of which are tidal salt marshes.<sup>436</sup> These tidal salt marshes are mostly fringing marshes, but there are also large acreages of back-barrier marshes, especially in Rehoboth Bay.<sup>437</sup>

The Delaware's Inland Bays provide one of the few areas in Delaware for colonial nesting waterbirds, including herons, egrets, gulls and terns. The rate of development within the bays' drainage and associated shoreline hardening would likely severely limit marsh migration during sea level rise. Loss of the fringing marshes and islands of the bays would significantly reduce or eliminate nesting habitat for these species in Delaware.<sup>438</sup>

The Maryland Coastal Bays Program considers shoreline erosion due to sea level rise and shoreline hardening major factors contributing to a decline in the amount of natural shoreline habitat available for estuarine species in the

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<sup>435</sup>Bleil, D., D. Clearwater, and B. Nichols, 2005, "Status of the wetlands in the Maryland coastal bays," Chapter 6.4 in Wazniak, C.E., and M.R. Hall (eds.), 2005, *Maryland's Coastal Bays: Ecosystem Health Assessment 2004*, DNR-12-1202-0009,

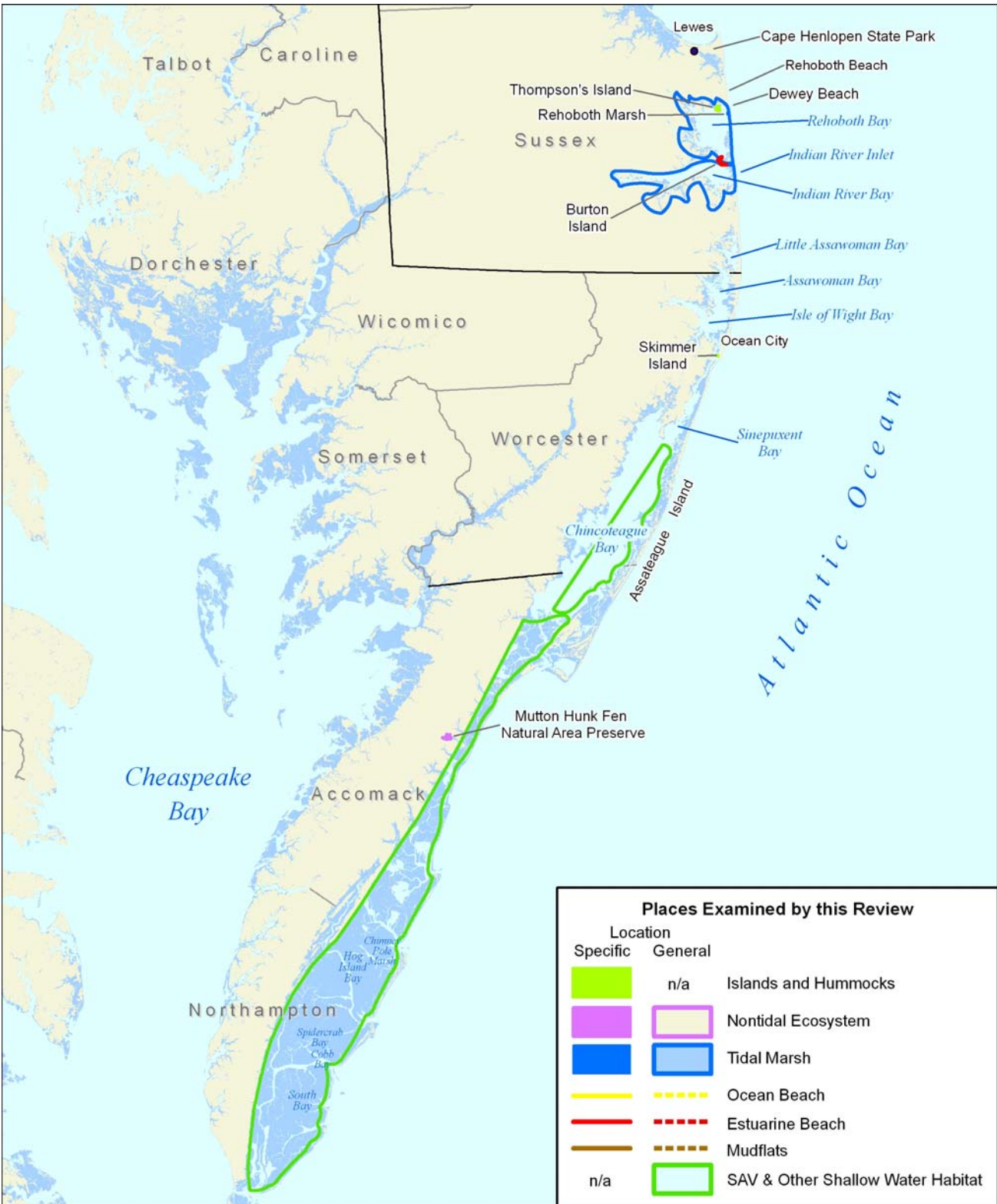
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Maryland Department of Natural Resources, Tidewater Ecosystem Assessment, Annapolis, MD, p. 6-33.

<sup>436</sup>Tiner, R.W., 2001, Delaware's Wetlands: Status and Trends. U.S. Fish and Wildlife Service, Ecological Services, Region 5, Hadley, MA. Prepared for the Delaware Department of Natural Resources and Environmental Control, Watershed Assessment Section, Division of Water Resources, Dover, DE. Cooperative National Wetlands Inventory Publication, Figure p. 9, text p. 16.

<sup>437</sup>Chris Bason, Center for the Delaware Inland Bays, email communication to Karen Scott, EPA, 5/14/07 (personal visual observation).

<sup>438</sup>Kevin Kalasz, wildlife biologist, Natural Heritage & Endangered Species Program, Delaware Division of Fish and Wildlife, in email entitled Opportunity to comment on U.S. EPA-sponsored papers related to sea level rise and related impacts on habitat and species, to Karen Scott of EPA, 2/16/07 (expert judgment based on official duty).



**Map 3.7. Locations and Types of Habitat Discussed in this Report: Atlantic Coast of the Delmarva Peninsula**

northern bays.<sup>439</sup> There has been significant shoreline hardening in Maryland's northern coastal bays (Isle of Wight and Assawoman), but little or no hardening in the three southernmost bays (Sinepuxent, Newport, and Chincoteague).<sup>440</sup> Planners expect shores in the southern part of Maryland's coastal bays to remain unprotected. Where natural shorelines remain, marshes in low-lying areas may expand inland as seas rise. Much of the shoreline of Maryland's northern coastal bays is protected using bulkheads or stone riprap, resulting in unstable sediments and loss of wetlands and shallow water habitat.<sup>441</sup> Armoring of these shorelines will prevent inland migration of marshes, and any remaining fringing marshes will ultimately be lost. The Maryland Coastal Bays Program estimated that more than 607 ha (1,500 acres) of salt marshes have already been lost in the Coastal Bays as a result of shoreline development and stabilization techniques.<sup>442</sup>

Loss of marshes will reduce habitat for many bird species that use the marshes for roosting, nesting, or foraging. Such species include black-bellied plover, dunlin, and horned grebe, wading birds such as herons and egrets, migratory shorebirds, rail species, including Virginia, king, and clapper rails, and many species of waterfowl.<sup>443</sup> Ducks and geese, including mallards, pintails, blue and green winged teals, gadwalls, canvasbacks, loons, buffleheads, mergansers, and golden eyes, overwinter in the bays' marshes.<sup>444</sup> A large

colony of American brant winters in Rehoboth and Indian River bays.<sup>445</sup> The Rehoboth marsh is known as an important area for colonies of nesting shorebirds and a food source for young birds.<sup>446</sup> The bays' marshes also provide nesting habitat for many species of concern to federal and state agencies, including northern harrier, American black duck, Nelson's sparrow, salt marsh sharp-tailed sparrow, seaside sparrow, coastal plain swamp sparrow, black rail, Forster's tern, gull-billed tern, black skimmers, and American oystercatchers. There is particular concern for Forster's tern because most of its breeding range is in the salt marshes of the mid-Atlantic.<sup>447</sup>

Marsh loss will also reduce habitat for resident and transient fish and shellfish species. Marsh resident fishes include mummichog, Atlantic silverside, and naked goby. A number of marine transients, including recreationally and commercially important species such as black drum, striped bass, bluefish, Atlantic croaker, sea trout, and summer flounder, depend on the marshes for spawning and nursery habitat. Important forage fish that move into the bays for spawning include spot, menhaden, silver perch, and bay anchovy, which are currently declining all along the Atlantic Coast. Shellfish species found in the bays' marshes include clams, oysters, shrimps, ribbed mussels, and blue crabs.<sup>448</sup>

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<sup>439</sup>Maryland Coastal Bays Program, 1999, *Today's Treasures for Tomorrow: Towards a Brighter Future; The Comprehensive Conservation and Management Plan for Maryland's Coastal Bays*, Maryland's Coastal Bays Program, Berlin, MD, Final Draft, June, p. 45.

<sup>440</sup>Hennessee, L., 2005, Status of the shorelines in the Maryland coastal bays, Chapter 6.5 in Wazniak and Hall (see note 435), p. 6-42.

<sup>441</sup>Maryland Coastal Bays Program, 1999, p. 6 (see note 439).

<sup>442</sup>Maryland Coastal Bays Program, 1999, p. 67 (see note 439).

<sup>443</sup>Dave Wilson, Maryland Coastal Bays Program. In June 13, 2006 email to E. Strange, Stratus Consulting, entitled "Follow up to my visit," providing review of draft text and recounting personal observations reported in a meeting on 16 May 2006. (Dave Wilson is the outreach coordinator for the Maryland Coastal Bays Program.)

<sup>444</sup>"Discover Delaware's Inland Bays," n.d., fact sheet, Document No. 40-01-01/03/03/01 produced with funding from NOAA by the Delaware Department of Natural

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Resources and Environmental Control, Delaware Coastal Programs. Available at: [www.dnrec.state.de.us/dnrec2000/Library/Misc/InlandBays.pdf](http://www.dnrec.state.de.us/dnrec2000/Library/Misc/InlandBays.pdf); and personal observations of Chris Bason (see note 437).

<sup>445</sup>"Discover Delaware's Inland Bays" (see note 444).

<sup>446</sup>Delaware Inland Bays Comprehensive Conservation and Management Plan, June 1995, Chapter 2: The State of the Inland Bays, p. 86.

<sup>447</sup>Erwin et al., 2006, p.16 (see note 58).

<sup>448</sup>Casey, J., and S. Doctor, 2005, Status of finfish populations in the Maryland Coastal Bays, Chapter 8.4 in Wazniak and Hall (see note 435), p. 8-34.

## Forested Wetlands

Forested wetlands occur along both tidal and nontidal creeks. Increasing instances of crown dieback and tree mortality in these wetlands are generally considered a result of sea level rise and an upstream shift in the salinity gradient. Where inland migration is not possible, the understory is being filled in with marsh plants, resulting in loss of tree habitats that are critical for many bird species, including bald eagles and a variety of breeding songbirds.<sup>449</sup>

## Sea Level Fen

A rare sea level fen vegetation community grows in the Angola Neck Natural Area along Rehoboth Bay.<sup>450</sup> This extremely rare type of coastal wetland grows only under the unusual circumstances where there is a natural seep from a nearby slope providing nutrient-poor groundwater to support its unique vegetation and where there is protection from nutrient-rich tidal flow (see Section 3.1, Overview, for detailed description of sea level fens).<sup>451</sup> Because of its location, the Angola Neck sea level fen could be lost as rising seas move inland, bringing nutrient-rich waters that are not tolerated by sea level fen vegetation.

## Coastal Plain Ponds

Coastal plain ponds are small, groundwater-fed ponds that contain many rare plant species. Because they are near sea level, these unique plant communities are particularly vulnerable to sea level rise. Such areas occur in the Delaware Inland Bays, especially within Assawoman Wildlife Management Area on Little Assawoman Bay.<sup>452</sup>

## Back-Barrier Beaches

The back-barrier beaches of the Coastal Bays have a number of important ecological functions. Horseshoe crabs spawn on these beaches,<sup>453</sup> and their eggs are an important food source for migrating shorebirds in spring.<sup>454</sup> *Photuris bethaniensis* is a globally rare firefly located only in interdunal swales on Delaware barrier beaches. The firefly's habitat is at risk because of beach stabilization and shoreline hardening, which limits dune migration and the formation of interdunal swales. Local ecologists favor research to ascertain whether protecting infrastructure from sea level rise might also increase erosion and further limit the formation of new interdunal swales.<sup>455</sup>

Northern diamondback terrapin spend most of their time in the marsh creeks and open waters of the Coastal Bays, but move onto the back-barrier beaches to nest and deposit their eggs along the upper beach.<sup>456</sup> Diamondbacks nest on back-barrier beaches and most types of estuarine beaches. In Delaware, they are known to nest on beaches of Burton Island.<sup>457</sup> They also regularly nest in residential areas, which may result from their natal imprint leading them back to former dune habitat that is now developed.<sup>458</sup> A natural instinct to get to the most suitable nesting habitat in the dunes nearer the ocean may be the reason some terrapins cross Route 1.<sup>459</sup> This has become a major management concern because many are killed by traffic.<sup>460</sup>

Loss of additional beach habitat due to sea level rise and erosion below bulkheads and other protective structures could have a number of negative consequences for species that use these beaches for egg-laying, foraging, or other critical

<sup>449</sup>Gary Fleming (personal visual observation) (see note 76).

<sup>450</sup>Delaware Department of Natural Resources and Environmental Control, Inland Bay Report. Accessed December 5, 2007 at: <http://www.dnrec.state.de.us/DNREC2000/Admin/WholeBasin/InlandBays/living.pdf>.

<sup>451</sup>Westerfelt, K., E. Largay, R. Coxe, W. McAvoy, S. Perles, G. Podniesinski, L. Sneddon, and K. Starkosch Walz, 2006, *A Guide to the Natural Communities of the Delaware Estuary: Version 1*, NatureServe, Arlington, VA, p. 258.

<sup>452</sup>Kevin Kalasz (see note 438) (personal visual observation) and Chris Bason (see note 437) (personal visual observation).

<sup>453</sup>Dave Wilson, personal visual observation (see note 443).

<sup>454</sup>Delaware Audubon Society. *Important Bird Areas in the Delaware*. Summary available at: <http://www.delawareaudubon.org/birding/globaliba.html>.

<sup>455</sup>Kevin Kalasz (see note 438).

<sup>456</sup>Dave Wilson (personal visual observation (see note 443).

<sup>457</sup>“Discover Delaware’s Inland Bays” (see note 444).

<sup>458</sup>Chris Bason (personal visual observation) (see note 437).

<sup>459</sup>Ibid.

<sup>460</sup>“Discover Delaware’s Inland Bays” (see note 444).

activities. Because terrapins bury their eggs deep within sandy sediment, where the eggs are protected against predators and other dangers, it is unlikely that they could reproduce in alternative habitats where it is more difficult to dig into the sediment to bury their eggs. Horseshoe crabs rarely spawn unless sand is at least deep enough to nearly cover their bodies, about 10 cm (4 in.).<sup>461</sup> Shoreline protection structures designed to slow beach loss can also block horseshoe crab access to beaches and can entrap or strand spawning crabs when wave energy is high.<sup>462</sup>

Erosion and inundation may reduce or eliminate beach wrack communities of the upper beach, especially in developed areas where shores are protected. Beach wrack contains insects and amphipod crustaceans such as fleas and beach hoppers that provide food for many species, including migrating shorebirds.<sup>463</sup> In addition, horseshoe crab eggs are sometimes ensnared in the wrack, where they are more accessible to foraging shorebirds.<sup>464</sup> Loss of wrack will decrease these food sources (for a more detailed description, see Section 3.1, Overview).

## Tidal Flats

Tidal flats are found at the seaward edge of the shorelines of both the Delaware and Maryland Coastal Bays. The benthic invertebrates of tidal flats typically include bivalves, small crabs, worms, and snails, which are important forage for shorebirds.<sup>465</sup>

The low-lying coastal plain and the fine unconsolidated sediments of the bays makes their tidal flats particularly susceptible to

inundation from sea level rise.<sup>466</sup> In areas where sediments accumulate in shallow waters and shoreline protection prevents landward migration of salt marshes, flats may become vegetated as low marsh encroaches seaward, which will further increase sediment deposition and lead to an increase in low marsh and a reduction in tidal flats.<sup>467</sup> Where sediment deposition is comparatively low, marsh may revert to unvegetated flat, at least in the short term, before the area becomes fully inundated.<sup>468</sup>

Reduction in the area of tidal flats will reduce invertebrate food supplies for wading birds, shorebirds, and dabbling ducks such as mallards and the American black duck. As rising seas cover flats with more and more water, they will become less available to foraging species, particularly short-legged shorebirds.<sup>469</sup> Tidal flats are critical for migrating shorebirds. Some researchers predict that as inundation increases and the area of tidal flats declines, increased crowding in remaining areas will lead to exclusion and mortality of shorebirds.<sup>470</sup>

## Shallow Waters and Submerged Aquatic Vegetation (SAV)

There are currently about 4,629 ha (11,438 acres) of SAV in Maryland's coastal bays, mostly eelgrass. Nearly 85 percent of eelgrass beds are found along the bayside of Assateague Island. Eelgrass in Maryland's coastal bays is generally limited to a maximum depth of about 1.5 m (5 feet).<sup>471</sup> Thus, unless conditions change, a 50–100 cm (20–40 in.) rise in sea level could potentially make areas where water depths are greater than 50–100 cm (20–40 in.) inhospitable to SAV.<sup>472</sup>

<sup>461</sup>Weber, R.G., 2001, Preconstruction horseshoe crab egg density monitoring and habitat availability at Kelly Island, Port Mahon, and Broadkill Beach Study areas, Prepared for the Philadelphia District Corps of Engineers, Philadelphia, PA, p. 4.

<sup>462</sup>Doctor, S., and C.E. Wazniak, 2005, "Status of horseshoe crab, *Limulus polyphemus*, populations in Maryland coastal bays," Chapter 8.7 in Wazniak and Hall (see note 435), p. 8-92.

<sup>463</sup>Dugan et al., 2003, p. 32 (see note 127).

<sup>464</sup>Jackson et al., 2002, p. 418 (see note 139).

<sup>465</sup>Burger, J., L. Niles, and K.E. Clark, 1997, "Importance of beach, mudflat, and marsh habitats to migrant shorebirds in Delaware Bay," *Biological Conservation* 79:283–292, p. 284.

<sup>466</sup>Johnson, Z.P., 2000, *A Sea Level Rise Response Strategy for the State of Maryland*, Maryland Department of Natural Resources, Coastal Zone Management Division, p. 9 and Figure 2.

<sup>467</sup>Redfield, 1972 (see note 132).

<sup>468</sup>Brinson et al., 1995, p. 655 (see note 23).

<sup>469</sup>Erwin, no date (see note 136).

<sup>470</sup>Galbraith et al., 2002 (see note 50).

<sup>471</sup>Wazniak, C., L. Karrh, T. Parham, M. Naylor, M. Hall, T. Carruthers, and R.J. Orth, 2005, Seagrass abundance and habitat criteria in the Maryland Coastal Bays, Chapter 6.1 in Wazniak and Hall (see note 435), p. 6-5.

<sup>472</sup>Short and Neckles, 1999, p. 175 (see note 91).

Researchers are uncertain whether the natural overwash process will keep water depths constant by providing enough sediment for the bay bottoms to rise as fast as the sea rises. Nor does anyone know whether inundated marsh on the mainland would be replaced by SAV. As a result, we are unable to say whether SAV in this area will increase or decrease as sea level rises.

The fate of SAV is very important for secondary productivity in the back-barrier bays of Maryland. Eelgrass beds are considered essential habitat for summer flounder and bay scallop and critical habitat for blue crab, which support substantial recreational and commercial fisheries in the coastal bays.<sup>473</sup> Therefore, the possibility of a net loss of eelgrass as sea level rises implies a risk to the local populations of flounder, scallop, and crab that are harvested in the coastal bays of Maryland. SAV is also important for many nongame species such as sticklebacks, pipefishes, and seahorses.

At present, SAV is almost absent from the Delaware Inland Bays because of eutrophication and turbid conditions in the bays' shallow waters.<sup>474</sup> However, reestablishment of eelgrass beds has been successful near Indian River Inlet, where ocean-influenced water quality supports growth.<sup>475</sup> In the future, poor water quality combined with increasing depth with sea level rise could impede SAV recovery in other parts of the bays.

## Marsh and Bay Islands

Islands within the coastal bays are important nesting areas for herons, egrets, black skimmers, gulls and terns. Laughing gulls, herring gulls, and great black-backed gulls nest on the marsh islands of Delaware's Inland Bays. Forster's

terns nest on dead marsh grasses on the islands.<sup>476</sup>

Marsh islands within the bays are undergoing rapid erosion. Big Piney Island in Rehoboth Bay experienced erosion rates of 30 ft/yr between 1968 and 1981, and is now gone.<sup>477</sup> Little Piney Island is another historical island in Rehoboth Bay that is completely eroded. Currently, Seal Island in Little Assawoman Bay is eroding rapidly after being nearly totally devegetated by greater snow geese.<sup>478</sup> The erosion of these islands and their potential submergence due to an inability to keep pace with sea level rise are of particular concern because these islands protect other natural and developed shorelines and marshes from increased erosion.

Hundreds of horned grebes stage for migration at the north end of Rehoboth Bay near Thompson's Island. Thompson's Island, part of the Delaware Seashore State Park, is located between Rehoboth and Dewey Beach, and is a significant birding area. Located only a half mile from the beach is the last stand of mature forest of white oak and loblolly pine along the Delaware coast. The island has several other habitat zones, including salt marsh. Resident species include some that are difficult to find along the coast, such as hairy woodpecker and belted kingfisher. The island is especially significant as a "migration trap," where migrating birds are funneled onto the island and "trapped" by 7 miles of inland bays and coast.<sup>479</sup>

Royal tern is a species that nests only on low-lying islands.<sup>480</sup> Although royal terns visit Delaware's Inland Bays in the summer, they do not nest there.<sup>481</sup> In the Maryland bays, royal

<sup>473</sup>Maryland Coastal Bays Program, 1999, p. 56 (see note 439).

<sup>474</sup>Delaware Department of Natural Resources and Environmental Control, 2001, Inland Bays/Atlantic Ocean Basin Assessment Report, June, p. 39.

<sup>475</sup>Delaware Department of Natural Resources and Environmental Control, n.d., Inland Bays/Atlantic Ocean Environmental Profile. Section on Water Quality: Water Resource Issues. Available at: [http://www.dnrec.state.de.us/water2000/Sections/Watershed/ws/i\\_b\\_atlantic\\_env\\_profile.pdf](http://www.dnrec.state.de.us/water2000/Sections/Watershed/ws/i_b_atlantic_env_profile.pdf).

<sup>476</sup>"Discover Delaware's Inland Bays" (see note 444).

<sup>477</sup>Swisher, M.L., 1982, The rates and causes of shore erosion around a transgressive coastal lagoon, Rehoboth Bay, Delaware, M.S. Thesis, College of Marine Studies, University of Delaware, Newark.

<sup>478</sup>Chris Bason (personal visual observation) (see note 437).

<sup>479</sup>Ednie, A.P., n.d., *Birding Delaware's Prehistoric Past: Thompson's Island at Delaware Seashore State Park*. Available at: <http://www.dvoc.org/DelValBirding/Places/ThompsonsIsland.htm>.

<sup>480</sup>Buckley, P.A., and F.G. Buckley, 2002, Royal tern (*Sterna maxima*), in Poole and Gill (see note 370).

<sup>481</sup>"Discover Delaware's Inland Bays" (see note 444).

terns nest only on Skimmer Island, which is currently only about 10 cm (4 in) above sea level.

There are numerous small islands in Maryland's Chincoteague Bay. However, stabilization of the Ocean City inlets and efforts by the U.S. Army Corps of Engineers to prevent formation of new inlets have inhibited the natural formation of new islands. The Corps has created many small dredge spoil islands, but most have disappeared as a result of erosion. These islands typically provide good nesting habitat for gulls, egrets, herons, American oystercatchers, glossy ibis, American black duck, American bald eagle, and osprey.<sup>482</sup>

Many of the small islands in the coastal bays are currently eroding, and may disappear altogether as rising seas inundate low-lying areas. Further loss of these islands because of erosion and sea level rise could result in severe reductions in island bird populations.<sup>483</sup>

The highest number of nesting American oystercatchers in Delaware are found nesting in the Inland Bays. They primarily nest on small sandy beaches and wrack on islands. Loss of nesting habitat for this species would dramatically reduce the population of American oystercatcher in Delaware.<sup>484</sup>

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<sup>482</sup>Erwin, 1996, p. 216 (see note 240).

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<sup>483</sup>Ibid.

<sup>484</sup>Kevin Kalasz (see note 438) (expert judgment based on official duty).