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The Virginia Wetlands Report

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Wetlands Program

Wetlands Mitigation Banks: Creating Big Wetlands to Compensate for Many Small Losses

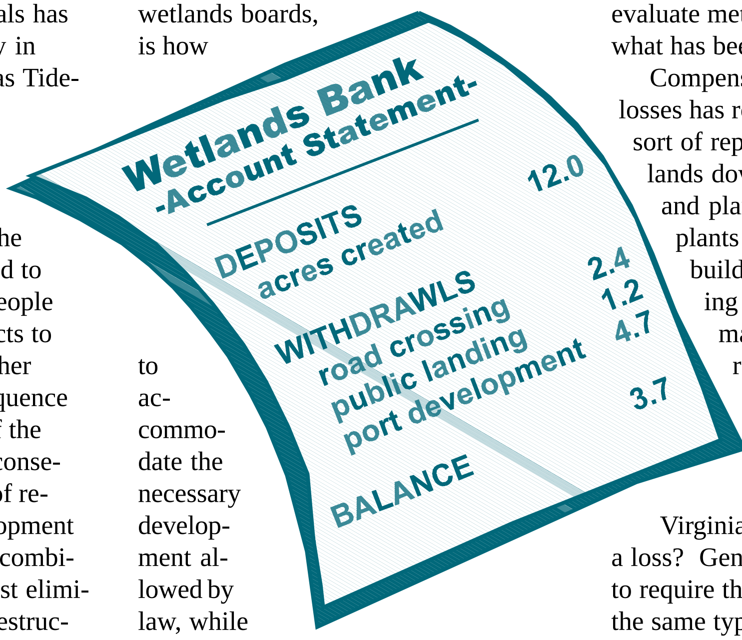
Carl Hershner

Wetlands mitigation banking is a relatively new tool for wetlands managers. It is finding increasing application in the struggle to achieve a "no net loss" goal for our remaining wetland resources. The concept of creating wetlands and thus establishing a "resource bank account" against which one can make withdrawals has tremendous appeal, particularly in rapidly developing areas such as Tidewater, Virginia.

The goal of preserving and protecting tidal wetlands in Virginia has become both easier and more difficult over the past several decades. Compared to the 1960's and 1970's, fewer people are proposing large scale projects to drain or convert wetlands to other uses. This situation is a consequence of growing public awareness of the value of wetlands. It is also a consequence of the vigorous efforts of resource managers to keep development out of these valuable areas. In combination, these factors have almost eliminated the threat of wholesale destruction of large tidal marshes.

On the other hand, the burgeoning population crowding into coastal areas, means small losses to shoreline development are a constant threat. Individually these losses seem insignificant, but cumulatively they amount to acres each year. When you realize that new tidal wetlands are not appearing naturally at a rate anywhere close to the rate of loss caused by man and nature, this "preventable" loss becomes a concern.

The problem confronting resource managers, such as Virginia's local wetlands boards, is how to accommodate the necessary development allowed by law, while still preserving as much of the resource as possible. Most wetland board members can recite from memory the mitigation "sequencing" process all wetland managers attempt to employ: avoid, minimize, compensate. The first objective is always to avoid the wetland if at all possible. Relocating development on a parcel of land, or redesigning a project can often preserve the existing resource. When avoidance is not possible, minimizing the area of impact is always the second objective. When an unavoidable loss of wetlands occurs, managers begin to evaluate methods to compensate for what has been destroyed.



Compensation for tidal wetlands losses has routinely involved some sort of replacement. Grading uplands down to intertidal elevations and planting native wetland plants is the accepted method of building a new marsh. Replacing a natural marsh with a man-made marsh has always raised questions of type, amount and location.

Which of the twelve types of vegetated tidal wetlands recognized in Virginia should be used to replace a loss? Generally managers have tried to require the created marsh to be of the same type as the destroyed marsh, replacement "in-kind." In reality, some types of wetlands are easier to establish than others. Additionally, some types of wetlands are recognized by the Virginia Wetlands Guidelines

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Wetlands Mitigation Banks
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as inherently more valuable than others. As a consequence, replacement "in-kind" is not always the preferred or optimal approach.

How much man-made marsh is required to replace an area of natural marsh is a debate which continues even today. It is generally recognized that the entire suite of functions provided by a natural wetland cannot be easily or speedily replaced by a created wetland. It takes many, many years for wetland soils to develop the chemical and biological conditions which allow natural marshes to play an important role in water quality for example. As a result of this potential inequality in function, managers generally require replacement for lost areas at a ratio greater than one. Two or three acres of created wetlands for every lost acre of natural wetlands are a typical requirement in the search for some equitable compensation.

Finally, where should the newly created wetland be placed? For many years, managers preferred to have compensation take place as close to the area of loss as practical. The rationale was that replacement "on-site" was most likely to preserve whatever benefits had originally been derived from the natural marsh. Increasingly, however, this practice has become less common. There are two reasons. First, losses along the shoreline often occur in areas where there are no truly suitable areas for creation of a new marsh. Second, we now understand that many of the processes which make wetlands valuable are heavily influenced by conditions on the adjacent upland. If development alters the adjacent upland, a wetland's ability to provide habitat and water quality functions can be significantly degraded. As a consequence, managers increasingly consider "off-site" wetland creation a desirable option.

Given the problems of assuring that a created wetland will succeed in becoming a functioning part of the landscape, how can a resource manager increase the odds of successful replacement? One solution is a wetlands mitigation bank. A mitigation bank is established by creating a large area of wetlands where none existed before. The new wetland can be considered a "resource account" which is then used to offset losses occurring elsewhere.

The key characteristic of a wetlands bank is that it is established in advance of any losses it will balance. From the resource manager's perspective this factor significantly increases the probability that the created wetland will succeed in developing some important features. Newly created wetlands typically take several years for the vegetative community to become established. Until that time, managers and/or developers can not be certain that either the hydrologic conditions or the type of vegetation are appropriate to allow the marsh to sustain itself. With a wetland bank, these questions can be answered before the first loss is offset.

The one thing that even a well established wetland bank cannot overcome is the effective restructuring of the landscape caused by development. It is possible to carefully select locations for wetland banks which will maximize their potential to serve important roles in water quality and habitat processes. Even the best location, however, represents a repositioning of those services on the landscape.

At this time we are still unable to fully assess the long-term consequences of rearranging our landscape with methods like wetlands banking. As a result enthusiasm for this management tool must be tempered by our continuing uncertainty. The most prudent approach for managers remains the original mitigation "sequencing" which calls for avoidance of loss as the first and most desirable step.

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In this Issue:

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— Feathers & Fins —

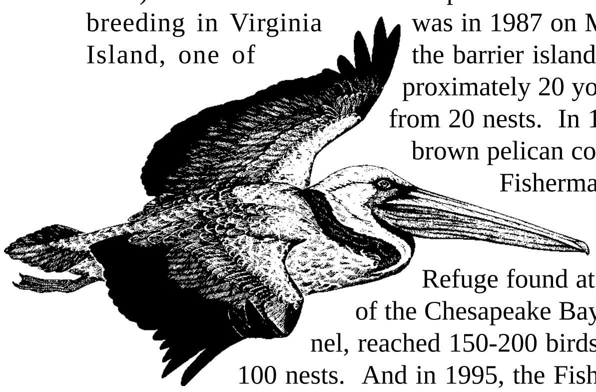
Brown Pelican

(Pelecanus occidentalis)

Julie G. Bradshaw

Have you noticed that there are more pelicans than there used to be around the Chesapeake Bay and the beaches of Virginia and North Carolina? (As I am writing this column in late April, a group of about 30 just flew over my office on our Gloucester Point campus.) The East Coast brown pelican population has made an impressive recovery from lows earlier this century. In the 1930's, pelicans along the Gulf Coast were destroyed by commercial fishermen who saw them (incorrectly) as serious competitive fishing threats. Then in the late 1950's, with the introduction of chlorinated hydrocarbon pesticides such as DDT, pelicans began suffering from eggshell thinning and the resulting reduced reproductive success. The brown pelican was placed on the federal endangered species list in 1970. In 1972 the U.S. outlawed nearly all chlorinated hydrocarbon pesticides. Nesting success began to improve in 1978, and in 1985, the pelican was removed from Endangered Species Act protection.

In Virginia, the Virginia Society of Ornithology (VSO) listed the brown pelican as a nonbreeding, "occasional summer visitor" to Virginia until 1980 when numbers dramatically increased. Peak counts of over 500 birds in the summer of 1984 were reported in the VSO's "blue book" (Kain, 1987). The first record of brown pelicans successfully breeding in Virginia was in 1987 on Metompkin Island, one of the barrier islands, with approximately 20 young produced from 20 nests. In 1990-92, the brown pelican colonies on Fisherman Island, the National Wildlife Refuge found at the north end of the Chesapeake Bay Bridge Tunnel, reached 150-200 birds, with nearly 100 nests. And in 1995, the Fisherman Island population was nearly 1000 birds, with 300 nests.



Brown pelicans are 1 of 2 pelican species which occur in the U.S., and 1 of 6 which occur worldwide. The other U.S. species is the American white pelican, which is a rare visitor along Virginia's coast. Pelicans are large stocky birds with large throat pouches which, in the larger American white pelican, can hold as much as 3 gallons of water. The brown pelican is one of the smaller pelicans, with a length of approximately 4 feet, and a 7 foot wingspan. The brown pelican is the only species that's not predominantly white, but is primarily a grayish brown. They are the only pelican spe

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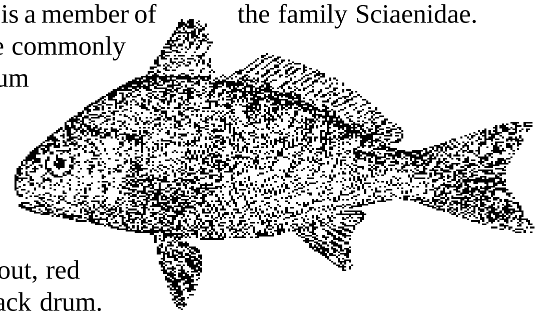
Spot

Leiostomus xanthurus

Lyle Varnell

The spot is a common Chesapeake Bay inhabitant which is highly significant to both the commercial and recreational fisheries. It ranges along the Western Atlantic from approximately Cape Cod, Massachusetts to the Bay of Campeche, Mexico; but is primarily concentrated in the Mid-Atlantic region, which includes the Chesapeake Bay. *L. xanthurus* is a member of the family Sciaenidae. Sciaenids are commonly known as drum fishes, and include the croaker, weakfish or gray trout, spotted seatrout, red drum and black drum.



The spot is morphologically distinguished from other sciaenids by a distinctly forked caudal fin and a large black spot on its shoulder (hence, the common name). It is also characterized by a deep, compressed body with a strongly elevated back. The dorsal fin is continuous with a notch between the spinous and soft portions. In all but the very largest members of the species there are generally 12 to 15 dark streaks running longitudinally along its sides.

Spawning primarily occurs during late fall and winter well offshore in moderately deep water. A typical adult female will produce between 70,000 and 90,000 eggs. After hatching the larvae inhabit nearshore and inner shelf waters. At about four months of age, the larvae are now juveniles and begin to enter estuarine environments. Within estuaries, juvenile spot generally prefer marshes and adjacent mud bottoms as nursery grounds, using the tides to move inshore. Juveniles remain in these areas until about September or October, when offshore migration to overwintering grounds begins. Some juvenile spot have been documented to remain within the estuary and overwinter in deep Bay waters, but the vast majority of the population are believed to prefer offshore waters.

Juveniles mature at the end of their second year or early in their third year. At the time of maturation they are generally between 7.5 to 8.5 inches total length. Adults migrate into the Bay in late winter/early spring and remain until late fall when they, like most juveniles, migrate offshore to overwintering grounds. The migration out of the Bay is usually complete by mid-December.

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Peat: Use Through the Centuries

Pam Mason

Peat. Everybody has heard of it, but do you know what is it, where it comes from and how it is used? Peat is partially decomposed vegetative material. It accumulates in areas that are water-saturated. The saturated soils and dead plant material create a condition without oxygen and the typical bacteria, worms and other agents of decomposition. Worldwide, peatlands cover about two million square miles. Peatlands occur around the world, but the largest are found in North America, northern Europe and Siberia. Canada and Russia account for roughly 75% of the world's peatlands, while the U.S. contains about 7 percent (Campbell, 1992). Cool climate, and flat, poorly drained lands provide the perfect conditions for the accumulation of peat. Peatlands are usually bogs (called moors in Europe and muskegs in Canada). Bogs are saturated by high water tables, with no significant inflow or outflow streams and are dominated by acid-loving plants, usually mosses of the genus *Sphagnum* (Mitsch and Gosselink, 1986). The harsh environment of peatlands sustains a relatively low diversity of plant and animal species, yet many are unique or rare. Some of the animals which use bogs include caribou, the northern bog lemming and the sand hill crane. Several species of plants grow only in bogs. Recent research indicates that peatlands have an important role in the storage and release of nutrients and may play a role in the balance of greenhouse gases (Breining, 1992).

Peat has been used for centuries as a fuel. This use continues today, especially in countries with large peat deposits and little, or no, coal or timber. More recently, peat has become important in horticulture as a soil conditioner, mulch and growing medium. The harvesting of peat, whether for fuel or horticultural use, is called peat mining. Russia accounts for about 95% of the peat mining in the world, with most of the peat used as for fuel electric power generation (Mitsh and Gosselink, 1986).

Depending on the intended use for the peat, there are several different methods of peat mining, also referred to as extraction. The method of extraction is influenced by the general stratigraphy of peat, which is basically two layers: the surface layer of living and newly dead moss is approximately 30 centimeters, and the lower black peat layer of varying depth. The extent of the removal of these layers results in varying environmental impacts and restoration possibilities. The most common methods of extraction are:

Open Black Peat Mining**:** Occurs after the looser, less decomposed top layer is removed. Large equipment is used to mining the peat with methods similar to open mineral mining.

Peat Extrusion**:** Used in shallow peatlands and small bogs. The peat is extracted by machine and extruded into sausage shapes to dry. Commonly used to produce peat for fuel.

Milled Peat Extraction**:** After the live surface vegetation is stripped off, the peat is loosened, formed into windrows to dry, and then collected with vacuum harvesters. Using this method, the top layer is often harvested as well, limiting the potential for restoration. Worldwide, milling accounts for about 90% of peat extraction

Sod/Block Trench Cutting**:** The traditional method of peat extraction. Still done by hand in places, but more often by specialized machinery. Blocks are cut from trenches and stacked to dry. The top layer is removed prior to extraction as it does not cut into blocks well.

In Ireland, the right of individuals to cut turf for domestic use is known as turbary. It has been estimated that 73% of the raised bogs and 11% of the blanket bogs existing historically in Ireland, have been lost. The loss rates have increased as the extraction method changed from hand dug, to mechanized.

(In the next installment, I will further discuss milling extraction, the environmental impacts of peat mining and some of the research on restoration efforts).

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Spot
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The spot's diet varies with size. For fishes between one and ten millimeters, small plankton is the food of choice. Up to 20 millimeters length the diet includes larger plankters such as copepods, mysids and amphipods. Juveniles and adults are benthic grazing generalists; eating infauna and epifauna such as harpacticoid copepods, polychaetes, amphipods, and bivalve siphons.

Spot use tidal wetlands as nursery and feeding grounds during their juvenile years. Adults use intertidal areas and subaqueous areas adjacent to wetlands as feeding grounds and as sanctuaries to avoid larger predators. As such, they play an important role in estuarine trophic links and the general ecology of the Chesapeake Bay and the coastal ecosystem.

GIS Geographic Information System

GIS as a Tool for Planning and Evaluating Wetland Mitigation Compensation Sites

Marcia R. Berman

Wetland mitigation and compensation are controversial, albeit promising regulatory vehicles for compensating wetland losses due to development activity. The scientific and management considerations have been discussed in articles by Barnard and Mason (1990) and were touched on in the cover story by Hershner. This article offers some examples where Geographic Information System (GIS) technology might assist in the selection criteria for site planning or subsequent monitoring activities.

A successful compensation wetland could be considered as one where the function and value of the wetlands on an impacted site have been replaced. This requires, among other things, proper placement in the landscape as well as a comparable plant and animal community structure. In these areas GIS offers some promising assistance.

Not all wetlands serve the same function or have the same value. The position in the landscape is an important determinant. For example, wetlands positioned between agricultural lands and tributaries act as sinks for nutrients, and therefore are valuable for their ability to improve water quality. Wetlands which fringe open water are valuable for shoreline erosion protection because they baffle incoming wave energy and protect the adjacent upland. Tidal wetlands serve an important habitat function for birds, fishes, and some species of invertebrates and mammals.

With some land use/land cover data to support the analysis, GIS can be used to look for attributes in the landscape where these functions and values are 1) needed, and 2) possible. If we were looking to replace a water quality/nutrient reduction value we would look in our land use/ land cover data for positions where these goals could be served. For example, we would not look at the headwaters of small creeks unless the contiguous land use was highly urban or heavily farmed. There would be little reason to create a mitigated wetland adjacent to a riparian forest since it would serve the same function. Rather you would search the landscape for places where no nutrient or storm water sinks currently exist and where wetland restoration would serve the most benefits.

Once you have identified places where you might like to have a wetland created for mitigation purposes you can also use GIS to evaluate whether the opportunity for creation is available. Things which need to be considered include soil type, hydrology, ownership, and present land use. All these attributes have one common bond. They can all be geographically referenced or mapped. As a result GIS models for the identification of mitigation and compensation sites can be developed that combine a specific set of predefined criteria for site selection, along with landscape analysis techniques.

Monitoring the success of a mitigation site is another challenge. A traditional use of GIS is to inventory natural resources which can be described by their position on the ground. One measure of success of a mitigation site will be the growth and development of a plant community structure that resembles the impacted marsh. GIS coupled with GPS technology has been used very effectively to survey vegetation patterns in marshes (both natural and mitigated) (Havens et.al., 1995; Havens et.al., in press). The GPS provides the accuracy required for measuring spatial patterns. The GIS provides the software platform within which characteristics between the two marshes (impacted and mitigated) can be compared. As well, GIS is very effective at making temporal comparisons to monitor change at one site over time. This is where GIS becomes an important monitoring tool to trace the development and health of the mitigated areas over the specified monitoring period.

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Wondering about Wetlands

William Roberts

Q Does my erosion control structure affect my neighbor's shore line?

A In almost all cases the answer to this question is "Yes, all erosion control structures affect adjacent shorelines". The real question and the most important consideration is "how" and "to what extent" does a shoreline erosion control structure affect an adjacent shoreline.

Shoreline defense strategies can, for simplicity, be placed into four general categories: to reflect wave energy, to dissipate wave energy, to accrete a sandy beach or intercept wave energy.

BULKHEAD and SEAWALL
Reflectors of wave energy

A bulkhead, constructed of concrete, pressure treated wood or rigid vinyl sheeting, is designed to intercept and reflect incoming waves thereby protecting the bank or backfill. The wave's energy is directed onto the bulkhead instead of the erodible shoreline. Unfortunately, bulkheads simply transfer much of the wave's energy along their face and eventually to an adjacent shoreline. If this adjacent shoreline is unprotected, the transferred wave energy will be spent on this shoreline and result in increased shoreline erosion. The use of return walls when constructing shoreline structures addresses the problem of reflected wave energies flanking the structure at the ends.

REVETMENT
Dissipator of wave energy

A riprap revetment functions to dissipate incoming wave energy and thereby protect the shoreline. Because riprap dissipates wave energy it is less likely to be transferred to unprotected adjacent shorelines and results in a minimal increase in erosion potential for adjacent shorelines. It is important to note however, that if the previously eroding shoreline was a major source of sand for beaches along adjacent downdrift properties, the loss of sand to the littoral sand system due to the revetment may indeed result in a loss of adjacent beach sand and increased shoreline erosion.

MARSH FRINGE
Dissipator of wave energy

While not a structure like the other methods of shoreline protection, vegetated wetlands can also serve as a wave energy dissipators. The stems of thickly growing wetland plants act in unison to baffle incoming waves thereby reducing wave energies and minimizing the potential for erosion along the shoreline.

GROINS
Sand accretor

Groins have long been used as a means of stabilizing an eroding shoreline and accreting or maintaining a beach along the shoreline. As explained in prior articles, groins function by intercepting and trapping sand moving in the littoral sand system (Virginia Wetlands Report; Vol.11, No.3). If groins work properly they will accrete sand in the form of a beach but they will also temporarily deprive downdrift shorelines of sand often resulting in an immediate loss of beach sand and increased shoreline erosion. Once the groin cells fill with intercepted sand moving in the direction of downdrift properties, they will, if constructed properly, begin to allow sand to pass down the shoreline from cell to cell and eventually reach the adjacent shoreline. Unfortunately, by the time the groin cells fill with intercepted sand, the effects on downdrift properties can be significant.

One method of preventing impacts to downdrift shorelines is to fill the groin cells immediately after construction with clean, beach quality sand that has a grain size equal to that found naturally along the shoreline. This artificial filling of the cells addresses the disruption in the littoral sand supply and minimizes the downdrift effects of groins on adjacent shorelines.

A second method of minimizing downdrift shoreline erosion is the installation of a short spur on the downdrift side of the last groin located approximately at mean low water. This spur minimizes the scour effect caused by the downdrift groin and reduces the loss of sand immediately adjacent to the groin.

BREAKWATER and SILL
Interceptors of wave energy

Offshore breakwaters, usually constructed of riprap can be thought of as being somewhat similar in purpose and function to both a bulkhead and a riprap revetment. As incoming waves strike the offshore breakwater some of their energy is dissipated or absorbed by the structure before reaching the shore thereby acting somewhat like a riprap revetment. In addition, breakwaters deflect or bend incoming wave crests aligning them parallel to the shoreline and redirecting their wave energy somewhat like a bulkhead. By having wave crests strike the shoreline in a parallel orientation, the movement of sand along the shoreline is minimized (see the related article, "Littoral

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Calendar of Upcoming Events

Oct. 12-16, 1997 **Estuarine Research Federation's 14th International Conference**
"The State of Our Estuaries." Rhode Island Convention Center, Providence, RI
Contact: Joy Bartholomew at 410-586-0997; jbarth@cbl.cees.edu.

Oct. 21-24, 1997 **VIMS Wetland Mitigation and Compensation Course**
Contact Bill Roberts, Wetlands Education Coordinator, at 804-684-7395. Lecture and field course. 4 days. $400.00.

June 8-12, 1998 **Society of Wetlands Scientists Annual Meeting**
Anchorage, Alaska. Contact Terry Brock: tbrock@ptialaska.net

July 12-15, 1998 **The Coastal Society Biennial Meeting. Minding the Coast: "It's Everybody's Business"**
Williamsburg, Virginia. Contact Mo Lynch, Conference Chairman, at (804) 684-7151
or email: tcs16@vims.edu.

Wondering About Wetlands
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sand movement" in the Spring, 1996 Vol 11, No. 2 VWR). In most cases areas of sand will accrete landward of the breakwater structure, provided there is sufficient sand in the longshore sand system. By dissipating wave energies, deflecting wave crests and accreting sandy deposits, breakwaters seem to combine the desirable characteristics of bulkheads, revetments and groins.

In summation, whenever contemplating the use of a shoreline protection structure, the potential impacts to adjacent properties should be considered. Some strategies or structures have a potentially greater negative impact to adjacent shorelines than do others. Scott Hardaway provides additional information and a detailed analysis of Chesapeake Bay shoreline environments in the Shoreline Erosion Guidance for Chesapeake Bay, Virginia section of the Virginia Wetlands Management Handbook.

Brown Pelican
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cies which regularly plunge-dives for food, diving from heights up to 60-70 feet above the water surface. Other species dive from the water surface. Fish and water are scooped up in the pouch, the bird surfaces and tips up the bill to drain the water out of the pouch, and then the fish are swallowed whole. Brown pelicans generally feed on menhaden, silversides, and mullet.

Pelicans generally nest in large colonies, usually of several hundred pairs. Nests in Virginia have been primarily in low vegetation in interdunal areas. Egg-laying in Virginia occurs primarily in May and June. The young can walk and climb at 5 weeks of age, and take their first flight at about 10-11 weeks. Pelicans usually begin breeding at 3-5 years of age.

Continuing threats to pelican populations include habitat loss due to encroachment on nesting areas, pesticides and discarded plastics and fishing line. The latter of these can entangle birds resulting in everything from strangulation to reduced feeding success. Hopefully, with proper management of our coastal resources, the brown pelican will continue to be a common sight around the Chesapeake Bay.

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1997 VIMS Wetland Education Programs

February 26 - 27 $200.00	**Winter Botany** - Public and Agency Field clothing, notebook, hand lens, land clippers, sharp knife, and ruler needed. Limit: 15 participants
May 6 - 9 $400.00	**Wetland Identification and Delineation** - Public and Agency Field clothing and notebook needed. Limit: 30 participants
June 18 $15.00	**VIMS Tidal Seminar** - Public
July 15 - 18 $400.00	**Wetland Plant Identification** - Public and Agency Field clothing, botanical guides, hand clippers, hand lens, and ruler needed. Limit: 20 participants
October 21 - 24 $400.00	**Wetland Mitigation and Compensation** - Public and Agency Field clothing and notebook needed. Limit: 30 participants
December 11 -12 $200.00	**Winter Botany** - Public and Agency Field clothing, notebook, hand lens, hand clippers, sharp knife and ruler needed. Limit: 15 participants

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