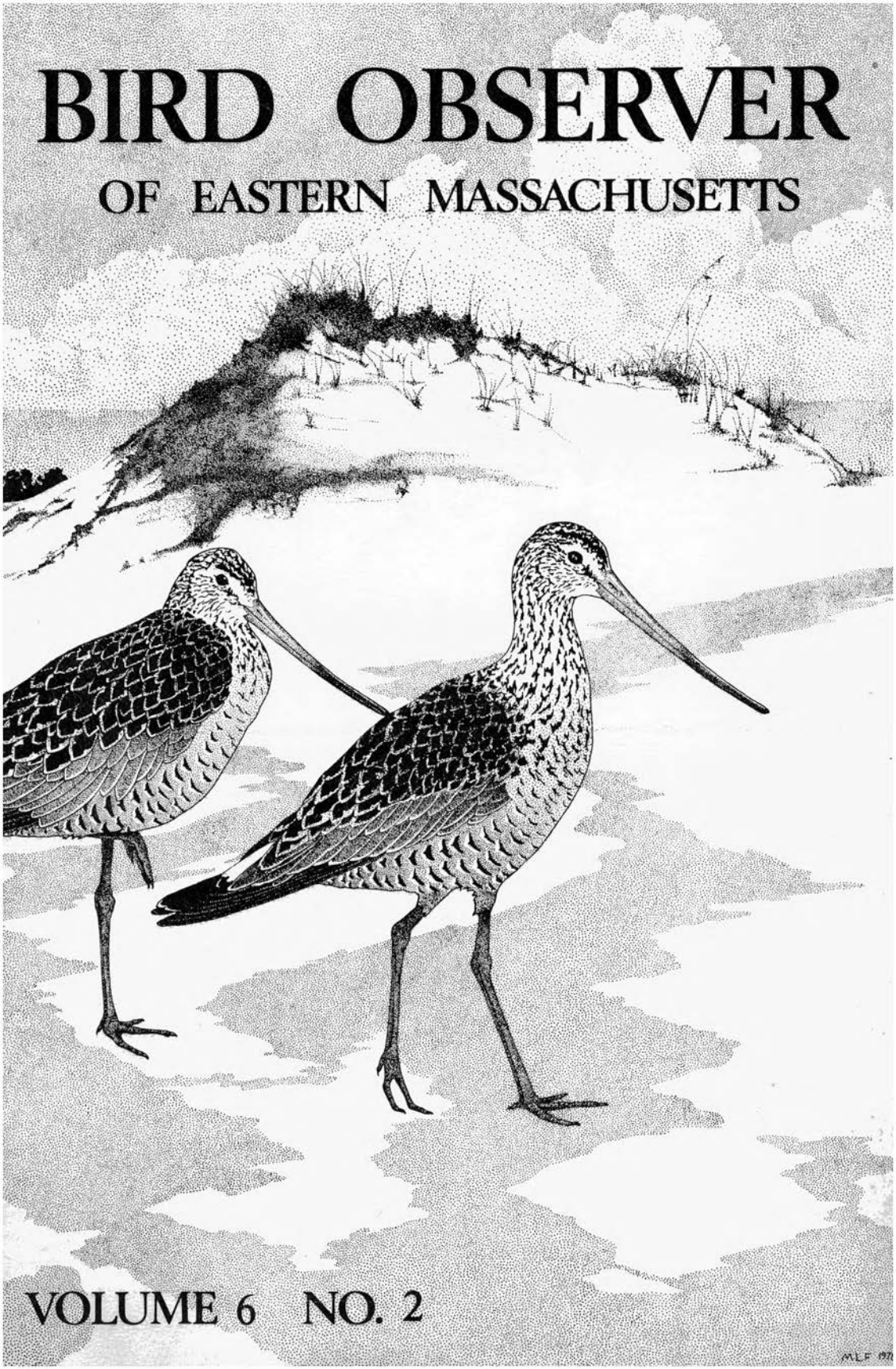
BIRD OBSERVER

OF EASTERN MASSACHUSETTS



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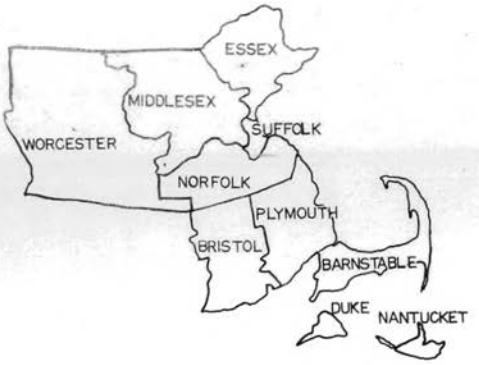

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Bird Observer of Eastern Massachusetts has been declared a non-profit tax exempt organization by the Internal Revenue Service. Any gifts to Bird Observer will be greatly appreciated and will be tax deductable to the full extent of the law.

RAPTOR INFORMATION NEEDED

Work is in progress on the preparation of a North American hawk watching guide. Persons who can provide color or black and white photographs of diurnal raptors perched or in flight, or who can provide site details on raptor migration lookouts, roosts, wintering areas, or other concentration areas are asked to contact Donald S. Heintzelman, 629 Green Street, Allentown, Penn. 18102.

PELAGIC TRIP TO GEORGES BANK

Limited space still available

Most New England birders are discouraged by the inaccessability of the really good pelagic birding areas. On June 19-21, Bird Observer is sponsoring a trip to the fishing fleet on the continental slope of Georges Bank, the most productive seabird region in the northeast. The 100' Yankee Capt.'s, with 48 bunks on board, will leave the Cape Ann Marina in Gloucester for Georges Bank at 10 p.m. on Monday, June 19, and will return on the morning of Wednesday, June 21 (around 2 A.M.), giving birders an entire day on the bank. The price is $52.00; please send payment promptly to: Robert Stymeist, 46 Beaver Street, Waltham, Massachusetts 02154. The fare includes transportation only and is refundable only in the case of foul weather.

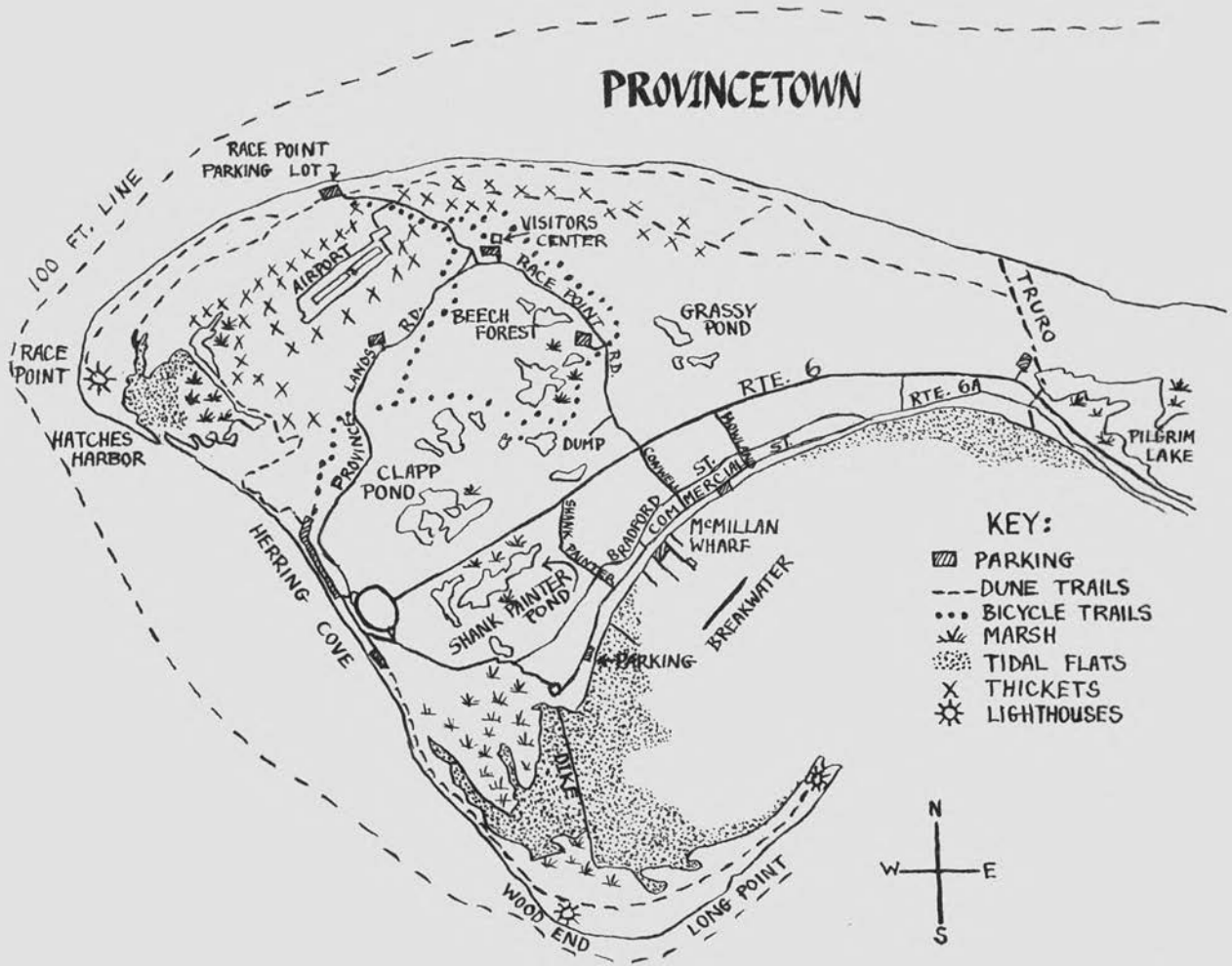
Leaders: Robert Stymeist and Richard Veit.

Georges Bank is located 110 miles from Gloucester at its closest point. Richard Veit spent June 1-14, 1977, in the area of Georges Bank, and observed the following: 300 Northern Fulmars, 20,000 Greater Shearwaters, 3,000 Sooty Shearwaters, 50,000 Wilson's Storm Petrels, many Leach's Storm Petrels, 25 skuas (including at least 8 South Polar Skuas, 2-3 Long-tailed Jaegars and much more--virtually anything is possible.

Negotiations on off-shore drilllng of Georges bank are still pending. This may be one of the last opportunities to visit this very productive fishing area before drillings begin.

GREATER BOSTON BREEDING BIRD CENSUS

On Saturday, June 17, 1978, a breeding bird census will take place. The area covered, the rules and the format will be the same as the annual Greater Boston Christmas Bird Count. In 1977, we recorded a surprising 112 species with limited coverage. (See BOEM Vol. 5, No. 5, p. 155 ff. for full report.) Anyone interested in participating in this worthwhile project is urged to contact Robert H. Stymeist, 46 Beaver Street, Waltham, Massachusetts 02154, or call 891-7313.


PROVINCETOWN
RACE POINT PARKING LOT
100 FT. LINE
VISITORS CENTER
AIRPORT
RACE POINT RD.
BEECH FOREST
GRASSY POND
TRURO
RACE POINT
PROVINCE LANDS RD.
RTE. 6
RTE. 6A
HATCHES HARBOR
DUMP
CLAPP POND
CONWELL ST.
HOWLAND ST.
COMMERCIAL
PILGRIM LAKE
SHANK PAINTER
BRADFORD
McMILLAN WHARF
HERRING COVE
SHANK PAINTER POND
PARKING
BREAKWATER
RACE
WOOD END
LONG POINT
KEY:
PARKING
DUNE TRAILS
BICYCLE TRAILS
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BIRDING IN PROVINCETOWN

by Blair Nikula, Harwich

Provincetown, that overgrown sand dune at the tip of Cape Cod, has long been neglected by birders visiting the cape, in spite of (or perhaps because of) its unique "isolated" location. However, increased observer activity in recent years has proven the area to be an exciting birding spot at any season, usually well worth the extra driving time required to get there (about two hours from Boston, thirty minutes from Orleans).

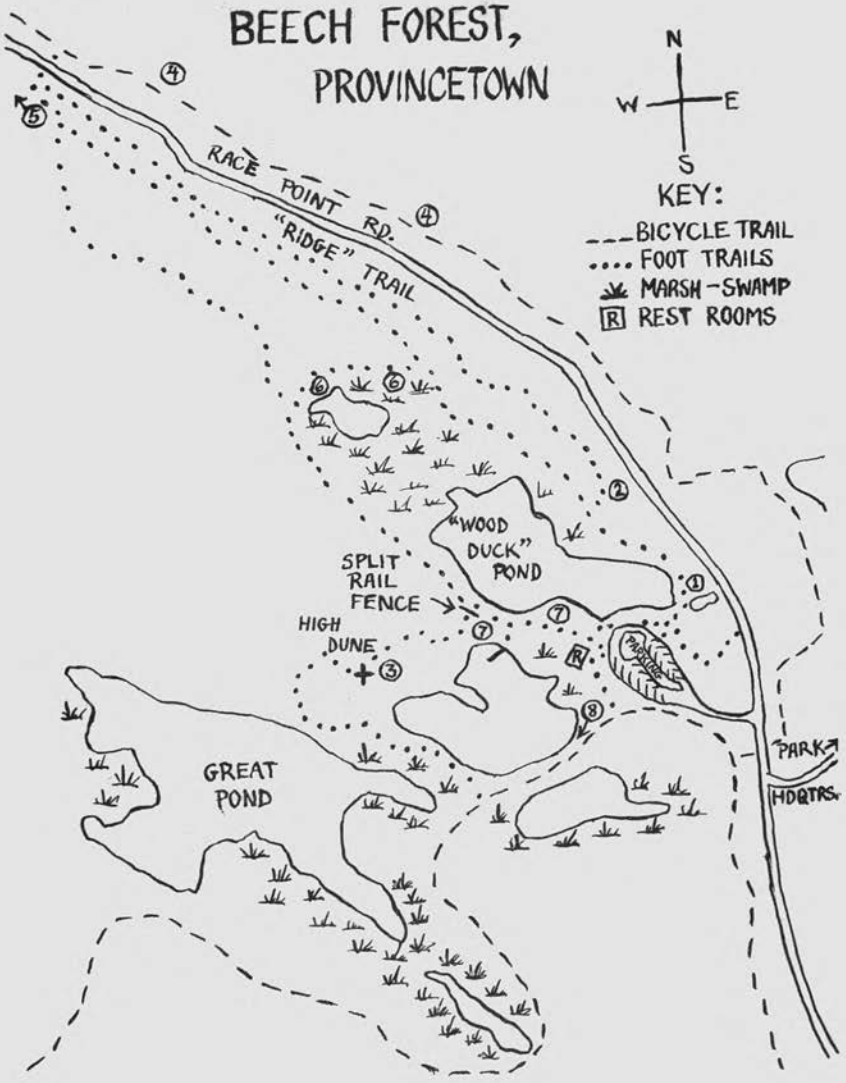
Wallace Bailey has always claimed that P'town--as it is known locally--is the best spot on Cape Cod to observe the spring passerine migration, and this has been amply confirmed in recent years. Pay no heed to those tho portray the cape as an avian wasteland in the spring! While it is true that the occurrence of spring migrants is more unpredictable than on the mainland and that the volume of migration is usually considerably less, the species variety is every bit as diverse and the birding can be spectacular. An added attraction has been the discovery of a substantial movement of hawks over the outer cape at this season with the resulting concentration of these birds in the P'town area.

The fall is also proving to be a very productive time for the birder and the area seems to be on a par with the better known coastal landbird traps. A northwest wind at this time of the year will often result in tremendous numbers of migrant passerines which can literally flood the dunes with sparrows, thrushes, vireos, etc. There has also been some indication that a southerly wind can be worthwhile (reverse migration?), but this has yet to be substantiated.

Perhaps the most alluring aspect of birding in P'town for many landlubbers is the presence of varying numbers of pelagic birds within sight of land at almost any time of the year but especially in the fall. On a day to day basis, this has been, at least in recent years, the best locale in the state and probably the east coast for land-based observations of pelagic birds. The frequent sightings of baleen whales serves as an icing on the cake.

That P'town often yields the rare and unusual has been amply demonstrated. In spite of rather limited coverage, the following "exotics" have been recorded recently: Mississippi Kite ('76), Swallow-tailed Kite ('72), Black Vulture ('76), Skua ('76), Le Conte's Sparrow ('76) and (probable) Arctic Loons ('76 and '78). Among the more "routine" rarities have been (most in the last two years!) Northern Fulmar, Manx Shearwater, Sabine's Gull, Common Murre, Common Puffin, Royal Tern, Red-headed Woodpecker, Western Kingbird, Prothonotary Warbler, Yellow-throated Warbler, Blue Grosbeak, Western Tanager and Lark Sparrow. This impressive list reflects the wide range of possibilities that the region offers.

Since birding in P'town is still more or less in its infancy, much of the information that follows is tentative and in some cases speculative, and as such, is subject to future revision. Accordingly, this article is intended merely as a guide and as encouragement to further exploration.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RACE POINT RD.
"RIDGE" TRAIL
"WOOD DUCK" POND
SPLIT RAIL FENCE
HIGH DUNE
GREAT POND
PARK HDQTRS.

Pilgrim Lake: During the first part of this century, this lake, created in 1869 by the diking of what was originally a saltwater harbor, was teeming with marsh birds and ducks. However, the encroaching sand and a 16-inch, man-induced drop in the water level (in the name of mosquito control) in 1958 have led to its demise. It is doubtful that any marsh birds are now breeding here and ducks, other than the ubiquitous Black, are a rare sight. A sandbar toward the west end attracts Double-crested Cormorants (April to October) and gulls including Iceland (November to April). The thickets along the east end of the lake occasionally harbor migrant landbirds and can be explored from a dirt road off Route 6 just before you reach the lake. To check the lake, you can pull off Route 6 onto the grassy shoulder, being careful to avoid the soft spots and storm drains. The grassy borders of the highway from here to the end (at Herring Cove) should be watched for sparrows, pipits, and similar birds during the spring and fall migrations. The high dunes at the dune parking area just past the lake may prove to be a good vantage for watching the spring hawk flight, but as yet they are unexplored.

Provincetown dump: If there are any vultures or eagles around, they are apt to be frequenting the dump. A Black Vulture spent a few days in May, 1976, in this area.

Beech Forest: This unique area is without a doubt the finest spot on Cape Cod to witness the spring passerine migration and is also worth checking in the fall, particularly late August to late September when the warblers are passing through. It is an oasis among the dunes with a couple of small marshy ponds surrounded by, among others, beeches, alders, six species of pines, and, most notably, oaks. Those places where oaks predominate are where one is most likely to encounter spring migrants. Fall migrants are more widespread and are apt to be found anywhere. Consequently, the following remarks pertain to the spring season when the location of the birds seems to be more predictable according to habitat. Species to be expected include all of the typical eastern Massachusetts migrants. Some of the better areas in the Beech Forest are as follows (numbers correspond to those on the accompanying map):

1) "Wooden Bridge." So far, this area adjacent to the parking lot has been the most consistently productive. If there are any birds around at all, they are apt to be here. Check the oaks on the opposite side of Race Point Road as well.

2) "Ridge Trail." This ill-defined and unmaintained trail branches off from the main trail approximately 100 yards from the parking lot. After passing a small stand of Scotch and Austrian pines on the right, bear right up the sandy slope and onto the trail along the top of the ridge. This is one of the highest spots in the Beech Forest and is usually good for warblers, vireos and thrushes. One advantage to this trail is that the birder is at tree-top level making observations easier. It also offers refuge from the nonbirding and often noisy weekenders.

3) "High Dune." So far this has proved to be the finest location in P'town to see the spring hawks. To reach it, watch for a section of split rail fence on the south side of the main trail. Turn south here (away from "Wood Duck Pond") and follow the sandy trail through the scrub pine to the highest vantage point. A clear view is provided in all directions and most of the town can be seen. It seems that sooner

or later most of the hawks present in the area on a given day will pass by this dune as they mill about, and the birder is often afforded excellent looks. All of the common raptors of the northeast can be expected here and some of the accidental southern species have been recorded as well. (Both the Mississippi Kite and the Black Vulture were seen at fairly close range from this dune.)

Other spots in the Beech Forest that are worth checking for landbirds are 4) the bicycle trail on the northeast side of Race Point Road, 5) the oaks at the far (northwest) end of the forest, 6) the west corner of "Wood Duck Pond," 7) the main trail from the split rail fence to the rest rooms, and 8) the bicycle trail from the rest rooms south between the ponds.

One final suggestion: try to avoid weekend afternoons as the crowds are often large and noisy and definitely interfere with the birding which of course is slow at that time of day anyway.

Visitors Center: This is another spot from which to see hawks; however, the light is often a problem here. Viewing can be done from either the parking lot or, better yet, the observation deck at the top of the building where the outer beach can be watched for falcons.

Airport and vicinity: This is mainly of interest in the fall when the many thickets attract numerous passerines, and accipiters and falcons are frequently seen in transit. Park at the Race Point parking lot and walk back to the airport (the airport parking lot is reserved for customers). From here, one may proceed southwest following the line of wet thickets that run between the dunes and the runway, keeping well away from the runway! If you are ambitious and continue far enough (approximately $1\frac{1}{4}$ miles), you will eventually end up at Hatches Harbor (see below). On a good day the complete route is, although arduous, definitely worth the effort. Another walk that can be worthwhile begins across the road from the airport, through the densely vegetated ravines that run eastward for about 2 to 3 miles through the dunes. Following a northwest wind in October this entire area can be packed with migrants and offers some lively birding.

Race Point parking lot: This is an excellent site for viewing pelagic birds at almost any season although mid-August to mid-December is the most fruitful. All of the regular northwestern Atlantic pelagic birds have been seen here, and the commoner ones can be seen regularly and occasionally in great numbers when conditions are favorable. Exactly why these birds occur with such consistency in this vicinity remains somewhat uncertain. Undoubtedly P'town's "at sea" location results in many seabirds being intercepted by this land mass as they move southward from the Gulf of Maine during the fall. Another possibly more important factor may be the presence of deep water (100 feet) close to shore in this area. Presumably this sharp drop-off results in some upwelling and in conjunction with the strong rips and currents characteristic of the region may provide a rich food source. This deep water line can easily be seen from the parking lot, if the sea is not too rough, approximately 800 yards out from the beach. Farther to the west this line occurs progressively closer to shore and is closest--approximately 200 yards--just north of the tip of Race Point (see map).

Generally the best weather conditions consist of cloudy skies with light to moderate northeast winds, although during the peak season (September and October) a few birds can be found under any conditions. When the winds are strong (40+ mph) from the northeast, viewing is difficult and usually little will be seen. Strong northwest winds following a northeaster can provide a good show as the pelagics that were blown into Cape Cod Bay by the storm stream back out into the open ocean. During the warmer months fog can be productive but one must be on hand at the precise time that the fog clears since little if anything can be seen before it does and the birds move out rapidly as visibility improves. As might be expected, southerly winds are the least productive.

This is perhaps the finest place in the Northeast for seeing jaegers. I know of no other region where they occur with the consistency with which they are found here. On any day from mid-August to late October, with a little patience one can expect to see at least two or three jaegers, and if conditions are right, counts of 50 or more are possible. Additionally, impressive counts of shearwaters have been made here in recent falls--totals of 1,000 to 5,000+ being recorded on a number of occasions.

During the spring and fall be alert for falcons moving along the outer beach as well as other migrating landbirds flying over. From May to October Vesper Sparrows can be found in the adjacent dunes.

While scoping, keep an eye out for whales as they occur throughout the year with largest numbers during the spring and fall. "Have you seen any whales?" is a question often hurled at the scope-wielding birder. Fin and Humpback whales are the most common but other species are possible and dolphins are occasionally seen as well.

Race Point: This point is unsurpassed for close observations of pelagics from land, presumably because of the proximity of deep water 200 to 300 yards offshore. Unfortunately, it is accessible only by foot or four-wheel drive vehicle from the Herring Cove or Race Point parking lots. Another drawback is that the conditions which bring the birds in the closest are strong northwest winds following a northeaster and observing then is very difficult, particularly if one is on foot. Watching pelagics from land is rarely a comfortable endeavor at any location. Much of the information on the Race Point parking lot above pertains to this area as well. During the winter months guillemots, Razorbills, and murres have been regularly found along the outer beach between the point and the parking lot. A calm day at this time of the year is often the best as these alcids are often seen sitting and feeding in the vicinity of the deep water line.

Hatches Harbor: As its name implies, this area once served as a harbor but has since sanded in, a fate to which every body of water in P'town seems doomed. It now consists of a small patch of salt marsh and some tidal flats separated from the bay by a spit of sand. On the east it is bordered, at this writing, by the remains of a man-made dike which was partially destroyed by the Great White Hurricane of '78. To the east of the dike lies the airport with its border of wet thickets. The flats and spit attract large numbers of gulls year round and terns in July to September, and occasionally the rarer members of their clan can be found. A few shorebirds are also usually present in season. Although the habitat is limited here, the "lands-end" location makes it the type

of spot where almost anything is apt to drop in. Access is by four-wheel drive or foot.

Herring Cove: This is another vantage point for viewing pelagics but, because the observer is at a very low elevation and the birds are usually at a considerable distance, it is generally inferior to the Race Point area (which is visible to the north). Poor light can also be a problem during the afternoon hours. Large numbers of terns feed here from late summer to early fall and often attract jaegers into easy viewing range.

Shank Painter Pond: This swampy pond is one of those places that looks so good yet has yielded little. Wood Ducks are sometimes present and night herons often fish the edges, but otherwise there is little to be said about the area. However, it is easily checked from Route 6 and probably should not be passed by without a quick look. Someday it will have a "biggie!"

The grassy edges of the highway along this stretch can be good for sparrows during migration and other passerines can sometimes be found in the surrounding thickets.

Wood End, Long Point and dike: I know little about this area but it would seem to have some potential as a birding spot. Access is gained only by foot or four-wheel drive from Herring Cove. The driving is very difficult--the toughest stretch of beach on the cape. The area is comprised of a typical barrier-type beach with saltmarsh and mudflats on the inside and vegetated with a few scrubby thickets. Black-crowned Night Herons nest here as well as do some terns. It is possible to park at the west-end rotary and walk out on the dike to Wood End, but this should be attempted only during the warmer months and only at low tide. Be very aware of the tides as the higher tides occasionally cover the dike. A young woman drowned here a couple of years ago when she became trapped by an extreme tide.

The mudflats may prove to be good for shorebirds in season and the thickets may harbor fall migrants. Small numbers of pelagics can probably be expected off the beach in summer and fall.

Provincetown Harbor: This has been one of the best known and most frequently birded locations in P'town. It is best during the winter when it attracts white-winged gulls, kittiwakes, guillemots, other alcids (mainly after storms), cormorants and numerous ducks. There are several vantage points from which to check the harbor, all accessible from Commercial Street. The best known is McMillan Wharf which is a fine spot to see the gulls, cormorants, and alcids (except guillemots). Alcids, when they are present, often occur very close to the wharf so be sure to look over the edge. There are also a couple of public parking lots off Commercial Street which offer good views of the harbor. The most favorable is on the west end (see map). From here, guillemots can occasionally be seen out towards the center of the harbor. They apparently are regular here and up to a dozen have been counted. There are extensive mudflats in the east end of the harbor but they seem rather unproductive.

Although I have outlined some of the more productive birding locations

in P'town, keep in mind that the dunes throughout town are full of wet, swampy thickets and during a good wave, any of them are apt to have birds. Keep an eye out for "pockets" as you drive around the area and be prepared to do a little exploring of your own. However, be aware that parking on the side of the road is prohibited along Race Point Road, Provincelands Road and sections of Route 6. This ban is strictly enforced and with good reason, so stick to the designated parking areas. Because parking is rather limited and many areas are not accessible by paved roads, considerable walking is necessary to cover the region well unless you are fortunate enough to own a four-wheel drive.

If you find some of your old birding spots are getting a little too predictable and you're ready for a change, give Provincetown a try. I think you will find it always intriguing, often exciting, occasionally disappointing, but rarely predictable!

NATIONAL WETLANDS INVENTORY MAPS ISSUED

The National Wetlands Inventory Program of the Department of the Interior's U.S. Fish and Wildlife Service moved a step forward with the publication of the first maps depicting wetland areas in the nation. The last national wetlands inventory was completed in 1954; since then much wetland modification has occurred.

The U.S. Fish and Wildlife Service is currently required to process approximately 35,000 permit applications per year for activities using wetlands. A recent court decision broadened the scope of Section 404 of the Federal Water Pollution Control Act amendments of 1972 to include all waters of the United States, thus adding to this work load. The National Wetlands Inventory Program will identify wetlands; help establish boundaries of controlled areas; and allow an area, region, or flyway analysis. This will reduce costly field examination and time-consuming permit-by-permit procedures.

Each year considerable funds are authorized for migratory-bird wetland acquisition. The inventory program will allow critical areas to be identified to help set priorities for acquisition.

THA

THE PEREGRINE FUND

The Massachusetts Division of Fisheries and Wildlife has moved to support a program for the reestablishment of the Peregrine Falcon in Massachusetts. Three were released in 1976, another 3 in 1977 at Mt. Tom, and more are scheduled to be released. The whole operation has been successful. Nationwide the fund needs $1.6 million for its work. Those interested in contributing should write: The Peregrine Fund, Massachusetts Audubon Society, South Great Road, Lincoln, MA 01773.

TO FIND A WAY HOME

by Philip Martin, Seattle, Washington

Each year, from around the end of May until the beginning of November, Greater Shearwaters cruise off the New England coast and throughout the North Atlantic. The entire estimated world population of five million birds, however, nests on three small islands in the South Atlantic, two million pairs alone on Nightingale Island, a speck of land no more than one square mile in extent, about half-way between Buenos Aires, Argentina, and Cape Town, South Africa. How do the shearwaters find their way over the boundless seas to their ancestral "needle-in-a-haystack" colony?

This is a dramatic, but by no means unique, illustration of the remarkable homing and navigational abilities of birds. The problem of how birds orient themselves and find their way from place to place has puzzled animal behaviorists for years. We are still a long way from truly understanding the phenomenon, but there have been intriguing advances in the field over the past twenty years.

Perhaps the problems of a navigating bird can be made more tangible if we compare them to the problems faced by a lost person. In order to find one's way in the trackless wilderness, one needs to know direction; in other words, a compass is necessary. However, we are not out of the woods yet; it does a lost person little good to have a compass if he does not know which direction to take. A map, too, is essential. In the figurative sense, birds too must have a map and compass.

What cues might birds use for navigation? Man has long used celestial information, the position of the sun and the stars, but until recently there was very little evidence to support the notion that birds also used a "sun-compass" or a "star-compass." Now it is virtually certain that some birds, at least, have this ability. Much of the experimentation that has been done has used our familiar friend the pigeon (albeit especially talented individuals bred for their homing ability) and Keeton (1974) has presented an excellent summary of the most important discoveries made in pigeon homing experiments.

Some of the first advances in the study of the sun-compass were made by Gustav Kramer in the early 1950's, using starlings as subjects. Kramer kept his birds in circular cages with several food cups located around the edge. He found that it was quite easy to train starlings to seek food at a cup located in a particular compass direction, regardless of whether the cage was rotated or moved to a different location. On sunny days the birds were able to locate a specific cup consistently; however, on overcast days the starlings' cup choice became random, and when the sun's apparent position was altered with mirrors, the starlings' cup choice was altered to match! This experimental evidence certainly indicated that starlings were able to use the sun as a compass, but there is a further complication. The sun is not a stationary light source; its position in the sky shifts approximately 15 degrees per hour (360 degrees of the circle divided by 24 hours in the day). If the birds were using the sun as a compass they must be able to correct for this apparent motion of the sun. Sure enough, when placed under an

artificial light source which acted as a stationary "sun," the starlings shifted their cup choice approximately 15 degrees per hour to compensate for the movement their internal clock told them must have occurred! (Griffin, 1964; Keeton, 1974).

This result indicates an accurate internal time sense must be operating in the birds, although we really don't know how accurate or very much about what keeps the clock ticking. The concept of an internal clock should be very familiar to anyone who has experienced "jet lag" after a transatlantic flight, or anyone who usually wakes up 10 minutes before the alarm clock is set to go off. We know that internal clocks and calendars function in many areas of animal behavior, bird migration and navigation among them. We shall return to this subject in discussing experiments which use manipulation of the birds' time sense to test certain theories.

The experiments of Kramer and others showed that birds could make use of the sun as a compass, but the "map" element of a navigation system was still unknown. In 1953, another of the pioneers in this field, G. V. T. Matthews, proposed what is known as the sun-arc hypothesis of bird navigation, which elegantly describes how a bird could get all of the information needed for navigation from solar cues (see Figure 1). There has been much argument about whether birds actually have the sensory capability to analyze solar movement with the accuracy demanded for this system. Most experimental evidence indicates that birds do not use this system, and one experiment described by Keeton is worth recounting here. In this test, the internal clocks of homing pigeons were disrupted. They were "time-shifted" six hours behind real time; this was done by keeping them in an enclosed room where the lights were turned on and off six hours after sunrise and sunset, respectively. (Day length and light/dark cycles are intimately associated with the maintenance of internal clocks and calendars in many animals and plants too.) These time-shifted birds were then released 100 miles south of home at noon, which was 6:00 a.m. to our time-shifted subjects. If a bird were using the sun-arc system it would "think" something like this, "It is 6:00 a.m. at home, but here the sun is in the noon position, therefore I must be horribly far east of home, and I must fly west." In actuality, the pigeons in this experiment headed in the opposite direction, to the east!

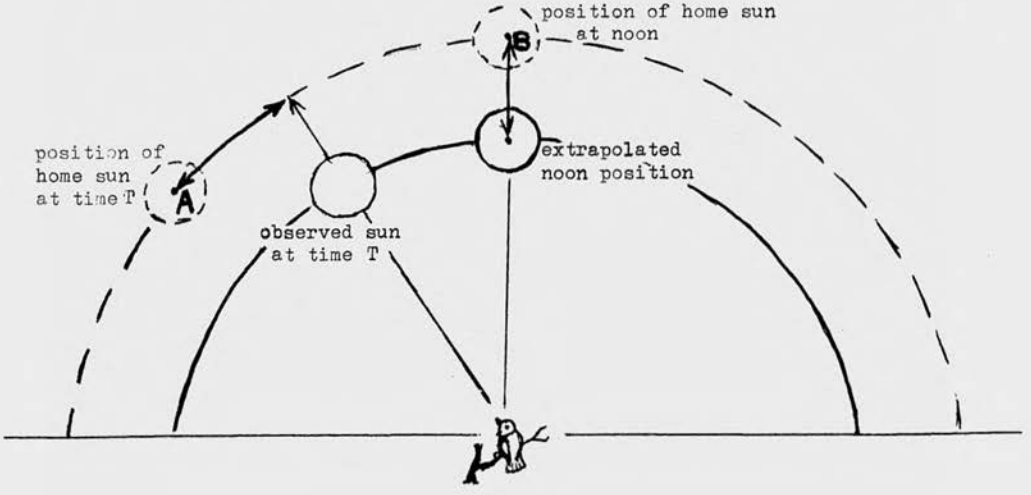


Figure 1. THE SUN-ARC HYPOTHESIS works like this: the bird who is displaced looks at the sun at time T and notes its position. By watching the sun's movement the bird extrapolates where the sun will be at its highest point--the noon position. The bird compares this noon position with the noon position of the sun at home by memory. In this case, the noon position at home is point B and since the noon position at the bird's present location is lower, it knows that it is north of home. The east/west displacement can be determined by comparing the observed position of the sun at time T with the bird's memory of how far along its arc the sun would be at time T at home. In this case, at home the sun would be at point A, not so far along its arc, so the bird knows it is east of home. To get back, it must fly in a southwesterly direction.

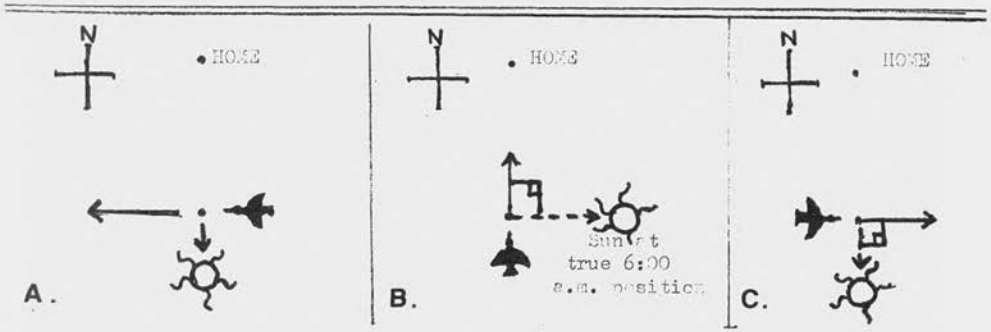


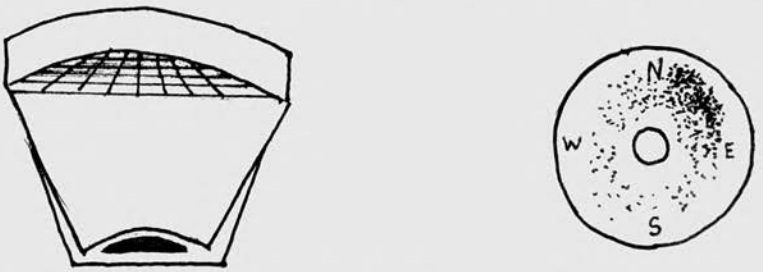
Figure 2. Figure 2A shows the predicted flight line of the time-shifted bird if it is using the sun-arc method. It sees the sun in the noon position (to the south) and since it thinks it is only 6:00 a.m., figures that it is drastically far east. It then flies off to the west. The experimental birds did not do this, they flew off to the east. If we take it for granted that the "map" tells the bird that it has to fly north, then thinking that the sun is at the normal 6:00 a.m. position in the east the bird would fly 90 degrees counter-clockwise from the sun as in Fig. 2B. However, since the bird is time-shifted six hours behind, and the sun is in the noon position, the same line of reasoning leads the bird to fly due east, as in Fig. 2C.

How to explain this result? If we assume that some unknown "map" tells our pigeon that it is south of home, then it would "think," "My clock tells me it is 6:00 a.m. and the sun is therefore in the east. I want to fly north which should then be 90 degrees counter-clockwise from the sun's direction." (Hang in there, Figure 2 should help you wade through all of this.) Since it is <u>really</u> noon, and therefore the sun is to the <u>south</u>, this 90 degree swing points the pigeon east. The catch in this explanation is that nobody has been able to identify the "map," so we are at something of an impasse, except that we are pretty sure that the pigeons are not using the sun-arc system.

There are large groups of migrants which are surely not using solar cues much for navigation--most passerines, some shorebirds, and sometimes loons, ducks, geese and alcids are nocturnal migrants. The orientation system of one nocturnal migrant in particular, the Indigo Bunting, has

been the subject of intensive examination by Stephen T. Emlen of Cornell University. His experiments are worth looking at not only for what they tell us about buntings, but also as a study in creative ornithology. The following account has been gleaned from several of his articles (Emlen, 1967a, 1967b, 1969, 1975).

Emlen's first experiments were designed to test the buntings' ability to use stars as an aid to navigation. A total of 33 buntings were captured during the spring seasons of 1964 and 1965, and kept in aviaries in, or near, Ann Arbor, Michigan. Experiments were conducted in spring and fall, when the birds showed readiness for migration, which can be determined in several ways. Prior to migration many migrants deposit large amounts of body fat as fuel for the journey (often 30% to 40% of the body weight). More important for these experiments is the phenomenon known as "Zugunruhe," a German term generally translated as "migratory restlessness." It has long been known that diurnal birds, which are usually quiescent during the nighttime, may shift their behavior dramatically during migration periods. They become very active from evening through most of the night; if they are in captivity the birds flutter against the cage repeatedly. It was also noticed that often these flutterings were oriented in the appropriate direction for migration (i.e., north in spring, south in fall), and this has become a valuable tool for experimentation.



Figures 3. At left is the Emlen bunting cage in cross-section. The floor is an ink pad; the sloping sides are covered with blotting paper, and a screened top permits a view of the sky. When the bunting undergoing migratory restlessness flutters up along the sides, its inky feet make marks on the blotting paper. At the right is a representation of a blotting paper record of a typical spring bird. As one would expect, the marks are heavily concentrated to the northeast.

When Emlen's buntings showed signs of migratory restlessness they were placed in specially designed cages (see Figure 3) with sloping sides covered with blotting paper and an ink pad for a floor. Thus, when a bird hopped up from the floor and fluttered against the side of the cage, its footprints were recorded on the blotting paper and later these marks could be analyzed to determine whether the bunting had a tendency to flutter in any particular direction. Some of the buntings were tested outdoors under natural sky conditions, and some were tested in a planetarium where the skies were subject to the whims of the experimenter. The birds tested outdoors over the two-year period generally showed the expected orientations--south in fall, and northeast in spring.

Tests in the planetarium yielded similar results, but there were some added twists. When south-orienting birds in fall were exposed to a

reversed sky pattern, in which the north star was actually projected on the south side of the planetarium, the birds reversed their orientation to correspond to the star pattern. During the spring, birds normally orienting northeast would head towards the southerly sector of their cages when faced with a reversed star pattern. Birds tested in the planetarium became less active and their orientation deteriorated markedly when the stars were turned off and diffuse "moonlight" introduced.

Having established that buntings did indeed orient by the stars, Emlen then set out to discover how they were doing it. He came up with two alternative possibilities.

1. They were locating a particular star or group of stars and then flying at a certain angle with respect to that star. Just as Kramer's starlings did with the sun, the buntings would have to compensate for the apparent movement of the stars across the sky, again dependent on an accurate internal clock. Only in this case the birds would have to deal with a vast number of stars, as opposed to only one sun. Furthermore, facing the north in the northern hemisphere the stars rise on the right and set to the left; in the southern half of the sky the stars rise on the east and set to the right. A bird would have to know what stars it was looking at in order to make the proper correction for their change in position.

2. The second possibility is that buntings were using fixed star patterns to point the way. We do this when we locate the north star, Polaris, by following an imaginary line passing through the "pointer stars" in the Big Dipper. The advantage of this system is that an internal time sense is unnecessary; the Big Dipper rotates around Polaris, but the pointers always point to Polaris, which is always in the north.

To test these hypotheses Emlen placed buntings under planetarium skies which were shifted out of phase with the birds' internal clock. If the buntings were using system #1 this would produce a situation where the birds' internal clock would lead them to make improper compensation.

As a hypothetical example, let us say the skies are shifted four hours ahead, then a bird's "reasoning" would run something like this, "My clock tells me that it is 10:00 p.m. and I should therefore fly 20 degrees to the right of star X in order to go north." But since the skies have been shifted, star X is really in the 2:00 a.m. position and is rotated 60 degrees counter-clockwise from where the bird thinks it is. That 20 degree compensation then is inappropriate and sends the bird off in the wrong direction.

On the other hand, if the bird was using system #2, then time-shifting would have no effect. In fact, when the experiment was conducted, with skies three, six, and twelve hours ahead of and behind real time, the bird was still able to orient correctly. This indicates that it was using star patterns, a system independent of time sense.

What star patterns were the buntings using, then? Emlen was able to play with nature on a grandiose scale in the planetarium, removing and replacing sections of the sky, individual stars, or constellations. He found that the buntings rely on the stars that lie within 35 degrees of

Polaris (including the constellations Cassiopeia, Cepheus, Draco, and Ursa Major, the Big Dipper). However, there was considerable variation among his test subjects regarding which stars were essential for navigation, and there seemed to be considerable redundancy in their guidance systems; that is, if one group of stars were blocked out, another group would suffice. Considering the situation on a partly overcast night, this would be a useful ability.

Later experiments showed that it is the rotational axis of the night sky (with stars rotating around Polaris) that serves as a reference system for buntings in learning to navigate. To investigate the development of navigational ability, it was necessary to raise young buntings from 4-10 days old (no mean feat in itself). The young birds were divided into three groups, raised under varying conditions.

Group I was raised in a diffusely lit room, without ever being exposed to a point source of light. During their first fall they were tested in the planetarium under simulated normal autumn skies. Their orientation was random.

Group II was raised without a glimpse of the sun, but they were allowed to view a simulated night sky in the planetarium every other night during August and September. The night sky was rotated in a normal fashion to duplicate natural conditions. Unlike the first group, these birds were able to orient south consistently.

Group III was also allowed to view the planetarium sky. However, instead of rotating around Polaris, the sky was made to rotate around Betelgeuse, a very bright star in the constellation Orion. When nocturnal restlessness began, these birds oriented 180 degrees away from Betelgeuse, responding as if it were the north star!

Apparently, young buntings learn how to navigate by observing the arcs of the stars' paths, thus locating the axis of rotation. Since older birds can orient under a fixed star pattern in a planetarium, the relationship of the stars is apparently learned and subsequently the buntings can navigate without actually observing any actual motion. Emlen suggests a fascinating hypothesis on the value of having young birds learn the axis of rotation, rather than having a fixed hereditary instruction which says something like, "Thou shalt follow the North Star in spring." He notes that there is a wobble in the direction to which the earth's axis of rotation points (like that seen in a spinning top) which causes the position of the pole in the sky to swing around in a circle 47 degrees in diameter every 26,000 years. Though the rate of this change may seem very gradual to us, it seems impossible that a genetically coded set of instructions could keep pace. By having each generation learn anew where the polar axis is located the problem of obsolete instructions is avoided.

Once the bird has learned how to locate the north/south axis, what tells it to fly one way along the axis in spring, and the opposite way in fall? Emlen sought to answer this question with an experiment involving "photoperiodism," the effect of day length on the physiological state. Photoperiod effects have been known for centuries--the ancient Japanese art of Yogai consisted of artificially lengthening the day lengths for cage birds by candle-light in order to induce mid-winter song (Welty, 1975).

Photoperiod has profound effects on the levels of production of many hormones, and these in turn have complex and interrelated effects on basic body functions and behavior, including the breeding cycle. Even a cursory look at this subject is beyond the scope of this article, but the reader should be aware of the basis for Emlen's tinkering in the experiment described below.

A group of male buntings were captured and kept in captivity over the winter. One group (the control) was exposed to day-lengths similar to what they would experience on their wintering grounds, as simulated by the lights in their flight room. These birds molted from winter brown to spring blue in February and April and began to show migratory restlessness in May. The second group was subjected to manipulations of the day-length as follows: in early fall the lights in their flight room were kept on for longer periods of time, simulating spring day-lengths of 15 hours. This caused the buntings to molt into spring plumage in January. Beginning in March, the day-lengths were shortened, so that by May they molted back to basic brown, and they too showed migratory restlessness.

Essentially then, Emlen had produced two groups of birds--one group physiologically ready for spring, the other for autumn. When tested under identical spring night skies in the planetarium, the "spring" birds headed north, while the "autumn" birds headed south, demonstrating that the directional choice was under physiological control. A similar result has been achieved with White-throated Sparrows, by administering directly doses of two hormones, prolactin and corticosterone.

These experiments have given us a better understanding of the migratory behavior of buntings than perhaps any other species, but there are still many gaps to be filled. The fact that the bunting navigation system seems to function independently of any internal time sense rules out the possibility that some nocturnal equivalent of the sun-arc system could be utilised to determine latitude, or tell a bird which way to go if it is forced off course. In other words, as with the pigeons' sun-compass, we have discovered the "compass" but the "map" element of the system remains unknown.

In contrast, early experiments by Sauer indicated that European warblers were capable of true bi-coordinate navigation by the stars. This points up one of the major difficulties in the field: there is no reason to expect all birds to navigate in the same manner. Rather, it is probable that different species use different systems, and perhaps the individual bird has a number of systems at its disposal.

This last possibility was strongly suggested to William Keeton when he noticed that some of his homing pigeons made it home on overcast days, hence without benefit of the sun-compass. Clock-shifted pigeons, while disoriented on sunny days, performed as well as normal birds under overcast skies. These results suggested an alternate system, independent of sun or internal clock that could be called upon when needed. What could this be? Obviously, homing pigeons can use simple visual cues when covering familiar ground, but they also home from unfamiliar locations and some pigeons can home while blind-folded.

One suggestion has been some kind of inertial guidance system, similar

to that used in modern rocketry. For instance, a homing pigeons being carried away from the home loft would sense the direction and magnitude of each acceleration over the entire journey, derive the vector sun and come up with a resulting distance and direction of displacement. Stranger things have happened but the theory has met with a good deal of skepticism.

However, another theory long held in disrepute has gained more acceptance in recent years. Researchers are coming up with more and more evidence to support the idea that birds may be able to detect magnetic fields, specifically the general dipole field of the earth and use this information for navigation purposes.

In the 1960's experimentation primarily by German scientists using the European Robin proved that directional choices could be influenced by subjecting the birds to an artificially produced magnetic field of similar intensity to the earth's at temperate latitudes. Later studies showed, surprisingly, that the horizontal component of the magnetic field (represented by the direction of a compass needle) did not influence orientation, while the vertical component (represented by the "dip" of a compass needle) did. The robins were apparently responding to the angle between the vertical component of the field and the pull of gravity (Wiltschko and Wiltschko, 1972).

Homing pigeons have also been found to be sensitive to magnetic fields. Magnets placed on the pigeons' heads did not interfere with their orientation on sunny days, but on cloudy days their orientation was reduced to random. In another experiment, devices known as Helmholtz coils were attached to pigeons' heads, powered by batteries strapped to their backs. The Helmholtz coil produces an electromagnetic field that can be reversed in direction. Again, no effect was produced on sunny days, but on cloudy days an amazing result occurred--when the electromagnetic field was oriented in one direction, the birds flew homeward, but when the field was reversed they tended to fly directly away from home!

A recent study used radar tracking of migrating birds passing over the antennas of the Navy's Project Seafarer site in Wisconsin. There are two antennas there which generate an ac current; at a distance of 100 to 900 meters, the strength of the magnetic field was calculated to be less than one percent of the earth's. The tracks of the migrants, as they flew over the antennas, were classified as "linear" if they proceeded in a straight line without deviation, or "non-linear" if they seemed to swerve over the antennas. The results were correlated with the condition of the antennas: whether they were off, whether either or both were on, or "changing" the current from 0-75 amps or 75-0 amps. Here are the results:

antennas condition	# linear	# non-linear
off	157	6 (4%)
on	204	28 (12%)
changing	53	21 (28%)

The significantly higher percentages on non-linear tracks in the second two categories indicates that migrants may be sensitive enough to shifts in magnetic field to react within minutes (Larkin and Sutherland, 1977).

The returns are not all in by any means. For instance, Emlen (1970) reported no apparent use of geomagnetic cues in Indigo Bunting orientation and found no evidence that they could detect magnetic fields. We have no idea what sense organs birds might use to detect magnetic fields, and very little idea of how they would actually translate this information to navigational instructions. Incidentally, it has been suggested that since anomalies in the earth's magnetic field often correspond to the position of mid-oceanic islands, sea birds such as the Greater Shearwaters mentioned at the beginning of this article might use this to locate their breeding colonies (Freedman, 1973).

It is difficult for us to deal with magnetic field detection because it is a sensory capability which we, ourselves, do not possess. Perhaps birds are capable of gathering other sensory input which we cannot detect. A recent study on homing pigeons incidates that they are capable of detecting very low frequency sound in the vicinity of 10 Hertz (Hz),* referred to as infrasonic radiation. Two shock electrodes and two ECG electrodes to monitor heart rate were placed in the pigeons. Infrasonic stimulus was given for ten seconds, followed by an electric shock, which resulted in acceleration of heart rate. After a few trials, a conditioned response occurred so that the heart rate increased when the birds were exposed to the sound stimulus even in the absence of the shock. Later experiments involving surgery proved that the receptors for infrasonics are located in the inner ear (Yadlowski, Kreithern, and Keeton, 1977).

There are many sources of infrasonic radiation: wind, thunderstorms, weather fronts, auroras, ocean waves, earthquakes, and many man-made devices. It would seem beneficial for birds to be able to detect many of these things, but it is not at all clear how they would use this information for navigation. (If birds do use infrasonic cues, one can idly speculate whether the ever-increasing presence of man-made devices producing low-frequency sound results in an adjunct occurrence of stray birds whose navigational systems have been "jammed".)

Beyond this, our theories get more and more speculative. When it is all said and done, we really have many more questions than answers about the riddle of bird migration. Recently, on a foggy morning at sea about 40 miles east of Cape Cod, I saw scores of warblers flying low over the water in all directions. It was a startling reminder of the fact that millions of avian deaths must result each season as migrants are lost at sea. However, the truly astonishing fact is that so many make it--hundreds and thousands of miles there and back again (Williams, et. al., 1977). Meanwhile, I think it is rather exciting that there is still such a basic unsolved mystery in ornithology. For the present, in the field of bird orientation and migration, we are almost as much in the fog as those warblers.

* To give some idea of what this means, the note middle C has a pitch of 256 Hz (often referred to as "cycles per second"). The note C an octave above middle C has a value of 512 Hz, double that of middle C. An octave below middle C has a pitch of 128 Hz, half the frequency of middle C, and so on. Our range of hearing is about 20 Hz to 20,000 Hz (about 10 octaves, if you work it out) although the lower end of this range is "heard" as vibration, and lower pitched sounds produced at sufficient volume are felt as pain, not sound. Ten Hz, therefore, is about an octave below the threshhold of human hearing.

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HAWK MIGRATION: A NEW HORIZON FOR BIRDERS

by Leif J. Robinson, Wellesley

Along what paths do migrant hawks fly? Do certain species have an affinity during migration? Are some prime hawk-watching sites still awaiting discovery?

These and scores of other questions were raised during the New England Hawk Watch Conference, held April 8th at Holyoke, Massachusetts. This regional meeting of the Hawk Migration Association of North America (HMANA) attracted about 250 enthusiasts, including founders of the "new awareness" in raptor migration studies, organizers, and members of the hard-core observing fraternity.

Conferences tend to provide perspectives rather than produce bombshells; this one was no exception. For example, Tom Gagnon reminded everyone that the large and predictable hawk flights at Mt. Tom were discovered by Joseph A. Hagar only 40 years ago. And only within the past few years has the tremendous accipiter migration along the Connecticut coast or the major flight line across eastern Massachusetts been detected.

It is impossible for an individual to recount all that was said at the HMANA conference; thefore, this will be a very personal view of what seemed important. For example, George Appell recalled his studies in Maine--the northeasternmost extremity of North America from which we have systematic records of the hawks seen passing by. In recent years he has noted an annual 10-percent increase in the number of migrating hawks (excluding the Sharp-shinned, which is especially numerous coastally). Appell's data are supported by records from Hawk Mountain, Pennsylvania. He also presented graphs which illustrated the day-by-day autumnal variation in the abundance of sundry species. But perhaps his most provocative comment pertained to "pulses" observed during heavy migration--pronounced peaks every 20 minutes or so in the numbers of birds seen passing a site.

From observations while flying a glider, Donald Hopkins has found evidence that hawks, particularly Broad-wingeds, travel in streams (rather than along broad fronts) separated by perhaps a dozen miles. By following birds peeling off the top of a kettle (a congregation of hawks in an uprising thermal), he learned that the Broad-wingeds headed toward another kettle, one that was invisible from the glider at the time. Yet, as we learn, we question. How does one reconcile, for example, the fact that Hopkins estimated 2,500 hawks passing over Mt. Tom at the same time ground-based observers reported only about 450?

Speaking for Vermont birders, Alan Pistorius suggested that the migration of Broad-wingeds may occur earlier far inland than at locations closer to the coast.

For Massachusetts hawk-watchers, Paul Roberts' recapitulation of the discovery of a major migration route in the eastern part of the state was the highlight of the conference. This flight line, extending from the Merrimack River past Mt. Wachusett, was found as a result of Roberts' organizing efforts and the participation of many members of the

Brookline Bird Club. (Incidentally, along this line lies Ft. Devens, where since 1970 Michael Olmstead has had good success banding migrant hawks; he summarized his results at the conference.)

Certainly, the visual highlight of the session was Michael Root's photographs of Northern Goshawk nests in Connecticut. Altogether he has studied some 20 nesting pairs and has reached some provocative conclusions. In particular, Root has found that the Goshawk seems to be changing its habits: the traditional "accipiter of deep northern woods" now adopts even forest edges. He also found Goshawk nests in rather close proximity to those of Red-shouldered Hawks and Great Horned Owls, which suggests that these species are not in direct competition for food. (This situation also prevails in Weston, Massachusetts, where I can add Barred Owls to the roster of cohabitants.)

Joe McDonald dealt with a topic of concern to everyone interested in raptors, the status of the Red-shouldered Hawk. This buteo was widespread three or four decades ago, but is now uncommon as a breeding species in the northeast. Its decline is due, at least in part, to its competition with the Red-tailed Hawk for nesting sites, a struggle in which the maturation of second-growth forests has favored the latter species.

Today, according to McDonald, the Red-shouldered has retreated to woodland swamps with hardwood trees 40 feet tall or more. (Again confirmed in Weston, where several Red-tailed nesting sites are also active annually.) Nevertheless, in prime woodland swamps, the Red-shouldereds nest closely adjacent to one another, about a mile apart. Of the approximately 50 nests McDonald observed from 1971 to 1976, an average of 2.29 young were produced per effort, which is probably sufficient to maintain a stable population. Also of interest were his statistics concerning the number of young present in those nests: 10 nests had 0 young; 4, 1; 19, 2; 16, 3; 1, 4.

Two hawk enthusiasts from Connecticut reflected upon observations made in that state during the past several years. Neil Currie cited data from closely spaced observing sites indicating that Broad-winged Hawks migrate along seven- to eight-mile fronts. (Note apparent conflict with Hopkins.) He also pointed out that a very strong northwest wind will tend to push the birds 30 to 40 miles nearer to the coast.

Arne Rosengren reviewed the amazing hawk counts at New Haven. On September 29, 1977, for example, more than 9,000 passed that city's lookouts, with the Sharp-shinned outnumbering the Broad-winged 6 to 1 or more! Coming from the east and north, these flights approach the coast at New Haven and then vanish westward, inland, along an as yet undiscovered route. The number of hawks that cross Long Island is still unknown, though proposals to answer this question were offered at the conference. (If you want to plan ahead for next autumn's migration, some of the best hawking in New England might take place at Lighthouse Point [New Haven] from mid-September through the third week of October.)

HMANA is a going and growing concern, and as its membership continues to expand more and more records will become available for analysis. Fortunately, the U. S. Fish and Wildlife Service has offered to computerize

this data. As Mark Fuller described, a new report form that he and Chandler Robbins have proposed will facilitate this data processing. Such a form--properly filled out--is essential for use by keypunch operators who may know nothing about birds but who are responsible for putting your observations into a language that can be understood by a computer.

The Passenger Pigeon, Heath Hen, and Carolina Parakeet became extinct without widespread public action. The recent plight of the Peregrine Falcon shocked a nation. Yet, it is still unclear whether this latter-day concern reflects a greater sympathy toward nature or merely apprehension for human survival. Has the canary in the coal mine only been replaced by the falcon in the field as our ecological early warning system?

HMANA is attempting to understand how and why the "visible raptors" survive, at home and on the wing. By this effort we may benefit; for this effort the association deserves your support.

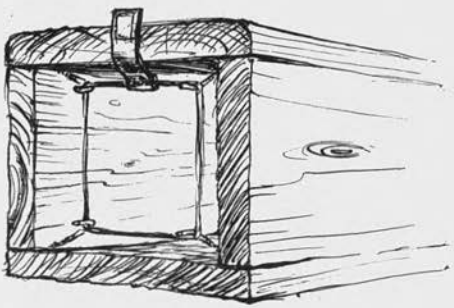
AN INNOVATIVE WAY TO TAG WOOD DUCKS

by Ronald Clayton, Winchester

Color-marking birds to study their movements is important. However, capturing and marking the birds often has adverse effects on their subsequent behavior. For example, disturbing a Wood Duck on its nest during egg laying or incubation may cause abandonment.

Now biologists at the Massachusetts Division of Fisheries and Wildlife have found a way to color-mark nesting Wood Ducks without handling them. A hook is screwed into each corner of the long predator guard on the box, and a large rubber band is stretched over the four hooks. When the Wood Duck enters the nesting box, the rubber band is dislodged and snaps around the duck's neck. A strip of brightly colored vinyl flagging attached to the rubber band makes it visible at one hundred yards or more. The vinyl flags are also numbered so that individual birds can be identified. Marking Wood Ducks in this manner does not affect their flying, feeding, preening, or egg laying.

The colors are designed for short-term use and begin to wear away after a couple of months. By the following spring, even the rubber bands may have disappeared. This new color-marking method is an important advance in learning more about Wood Ducks during the nesting season without the risk of eggs or young being abandoned.



BIRD OBSERVER REPRINTS

Each year many new subscribers request back copies or volumes of Bird Observer to complete a set, or more often than not, they are interested in a particular bird-finding article. Below is a complete list, by volume, of all the "where to go" articles. You may purchase back volumes for $6.50 per year, or individual copies for $1.25 through our subscription manager at Bird Observer, 462 Trapelo Road, Belmont, MA 02178.

As always, Bird Observer is pleased to receive material on topics of field ornithology, bird-finding articles, or updates of any area you would like to share with us. Bird Observer exists to serve the local birding community; thus readership participation is not only desired, it is essential.

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SUMMARY FOR DECEMBER, 1977

December was wet, a bit on the mild side and under average on the snow side. The temperature averaged 34.2°, 1.2° above normal and 5.2° warmer than December, 1976. Temperatures fluctuated often with 7 days averaging 10° or mor above normal and 5 days averaging as much below normal. The warmest day was the 21st, when the mercury hit 55°, 17° above normal, and the coldest temperature was 5° on the 12th, 22° below normal.

Precipitation totaled 6.20 inches, 1.96 over normal. The most in any day was 1.35 inches on the 1st. Measureable amounts fell on 16 days. Snow totaled only 5.2 inches, 3.0 less than average. The most in 24 hours was but 1.8 inches on the 5-6th. Some western and northern suburbs had much heavier snow fall. Wind everaged 14.2 mph; the fastest mile averaged was 49 mph from the northeast on the 6th, the peak gust registered 50 mph from the northwest on the 10th.

The 78th Christmas Bird Count (CBC) was held between December 17, 1977, through January 2, 1978. This summary contains a great deal of records submitted by the compilers of various counts. In order to avoid the repeating of dates, the following chart should be used for determining the date of the record.

CBC	DATE	COMPILER
Athol	12-26	Robert Coyle
Buzzards Bay	12-17	Richard Harlow
Cape Ann	12-18	Sally Ingalls
Cape Cod	12-18	Wallace Bailey
Greater Boston	12-18	Robert Stymeist
Martha's Vineyard	12-17	Gus Ben David
Millis	12-17	John Marshall, Jr.
Nantucket	12-18	Edith Andrews
Newburyport	12-26	Richard Heil
Plymouth	12-28	Trevor Lloyd-Evans
Quincy	12-17	Sibley Higginbotham
Tuckernuck	12-17	Richard Veit
Worcester	12-17	Francis McMenemy

LOONS THROUGH HERONS

On Nantucket 244 Common Loons and 50 Red-throated Loons were noted on the 18th (CBC), 44 Common Loons on the 26th (Newburyport CBC), and 59 were seen on the Plymouth CBC on the 28th. Red-necked Grebes were noted in small numbers with 3 on the Quincy CBC, 2 on the Nantucket CBC, and 4 on the Plymouth CBC (TL, LE). A total of 227 Horned Grebes were noted during the month. The Cape Cod CBC recorded 37 Pied-billed Grebes; the northern-most report of Pied-billed Grebes was 2 birds on the 5th in Salisbury (DCA). An unidentified shearwater was observed off 1st Encounter on the 7th (CAG, BN). On the 18th, the Nantucket CBC recorded 780 Gannets; the Cape Cod CBC on the same day recorded 120. Great Cormorants totaled 436 on the Quincy CBC, 161 on the Greater Boston CBC, and 140 on the Cape Cod CBC. Double-crested Cormorants were noted from Revere on the 2nd, when 3 were reported (SZ), an immature from PI on the 3rd (WRP, RPE), 3 from the Cape Cod CBC, and 2 (1 adult and 1 imm.) on

the Plymouth CBC.

Thirty-six Great Blue Herons were noted during the month, as were 44 Black-crowned Night Herons. A Snowy Egret was found on the 17th on Martha's Vineyard (CBC). American Bitterns were found on the Tuckernuck (3), Cape Cod, Newburyport (2) and Plymouth counts.

WATERFOWL

Six Whistling Swans were reported from Martha's Vineyard on the 17th (CBC), 30 Mute Swans were noted in Lakeville on the 23rd (PH). Canada Geese totaled 2386 on the Cape Cod Count, and 1829 on the Newburyport CBC. Brants were noted in good numbers with 933 (Quincy), 98 (Boston), 1413 (Cape Cod), 126 (Plymouth), 10 (Newburyport). A single Snow Goose was noted from Braintree on the 1st (BAL, MFL), 2 were seen on the Martha's Vineyard and the Newburyport CBC. Black Duck CBC totals were as follows: Quincy-1609, Boston-1444, Cape Cod-1413, Newburyport-9326, and Plymouth-1064. Eighty-five Gadwalls were noted in Ipswich on the 3rd (WRP, RPE), and 14 were noted from GMNWR on the 2nd (RKW). There There were still 60+ Pintails on PI on the 1st (P. Miliotis), and 95 were noted from Yarmouth, and 20 were seen in Barnstable on the 27th (BN, VL). The last Pintail was seen at GMNWR on the 9th (RKW). Green-winged Teal totaled 102 on the 1st at PI (P. Miliotis) and 150 were noted on the Nantucket CBC. Single Blue-winged Teal reports came from GMNWR on the 15th and 16th (RKW) and from the 27th to 31st in Sandwich (RFP). Five European Wigeons were noted on the Nantucket CBC, where 434 American Wigeons were counted; other American Wigeon CBC totals were 52 in Greater Boston, 37 in Plymouth. As many as 9 Northern Shovelers were reported from GMNWR on the 2nd (RKW), 8 were noted from PI on the 4th (P. Miliotis), and a record from Boylston on the 28th was interesting (HLM). Over 28 Wood Ducks were noted during the month from 8 localities, including 11 from Westport on the 1st (WRP#).

Redheads totaled 90 on the Buzzard's Bay CBC, and 143 were noted on the Nantucket CBC; 13 other individuals were reported. Ring-necked Duck totals were very low with only 4 noted on the Nantucket CBC, 42 on the Cape Cod CBC, and 17 on the Plymouth CBC. Canvasbacks retreated to Bristol County and the islands when ice began forming on all the ponds; 100 were noted from Acoaxet and 1200 from Assonet on the 11th (SSBC-WRP); 500+ were noted on the Nantucket CBC. Greater Scaup CBC totals: 3290 in Quincy, 3608 in Greater Boston and 1118 on Nantucket. Lesser Scaups were noted on the Nantucket CBC with 35, and 3 on the Plymouth CBC. Other reports included 10 in Lakeville on the 3rd (RRV#) and a single bird in Framingham on the 25th (RAF). CBC totals for Common Goldeneyes were Quincy-859, Boston-627, Nantucket-1151, Cape Cod-756, Newburyport-1028, and Athol recorded 4, which was new to their count. Eleven Barrow's Goldeneyes were noted as follows: singles from Assonet on the 11th (WRP), N. Scituate on the 16th (P. Anderson), Tuckernuck (CBC), Orleans (CBC), Plymouth on the 27th-28th (WRP#); 2 birds were reported from the following locations: Cape Ann (CBC), Boston (CBC), and in Scituate Harbor from the 17th-26th (SH#). Totals of Buffleheads include Quincy-616, Boston-695, and Cape Cod-1102. The stronghold for Oldsquaws is certainly off Nantucket; on the 17th Tuckernuck recorded 26,500, and the Nantucket CBC count numbered 14,521 on the 18th. Five Harlequin Ducks continued throughout the month in East Orleans (v.o.)

and as many as 5 were seen off and on in Magnolia (v.o.); singles were noted off Cohasset on the 16th-17th (SH) and one was seen in Scituate on the 4th (WRP#). Common Eider CBC totals were: Quincy-4395, Boston-4020, Tuckernuck-5015, Nantucket-11,704, Cape Cod-1492, and Plymouth-6880. Two King Eiders remained throughout the month in E. Orleans (v.o.), singles were noted in Quincy (CBC-SH), and in Rockport on the 21st (JG, LC). Two were noted in Mashpee on the 23rd (PH) and 2 were seen in Ellisville on the 28th (TLL'E). At Tuckernuck 1398 White-winged Scoters, and 975 Black Scoters were noted on the CBC, and Nantucket's CBC recorded 1901 Black Scoters. Seventy Ruddy Ducks were seen on the Cambridge Reservoir in Lincoln on the 4th (RAF), but my nonth's end very few were reported due to the freezing ponds. The Cambridge Reservoir also harbored 54 Hooded and 195 Common Mergansers on the 4th (RAF). The Cape Cod CBC reported 201 Common Mergansers and the Plymouth CBC noted 217. Red-breasted Merganser CBC totals were: Quincy-659, Boston-297, Cape Cod-265, Nantucket-795, Newburyport-136, and Plymouth-556.

RAPTORS

A very late Turkey Vulture was observed flying over Nahant on the 2nd (SZ); the previous late date was 11/17/58 in Truro, and there is one winter record from Chatham, 1/17/63. Nine Goshawks were noted. Twenty-eight Sharp-shinned Hawks were reported and a single Cooper's Hawk was identified in Lancaster on the 31st (HLM). The number of Red-tailed Hawks were especially noteworthy with 32 on the Boston CBC, 23 on the Worcester count and 37 on the Newburyport CBC. Single Red-shouldered Hawks were noted from Millis on the 17th (WED), Wareham (CBC-WRP#), Brookline (CBC-AA) and in Orleans (CBC). Rough-legged Hawks were reported in exceptional numbers with 54 individuals noted throughout eastern Massachusetts. An immature Bald Eagle continued in Orleans through the 18th (RMB#, v.o.). Total CBC counts of Marsh Hawks were: Tuckernuck-6, Nantucket-28, Cape Cod-15, Newburyport-7. There were 9 additional birds reported from 7 locations. An Osprey was found on the Martha's Vineyard CBC. However, it died a short time later. A single Peregrine Falcon was reported over Dorchester on the 23rd (JDO'R). Single Merlins were noted from Eastham on the 4th (RMB#), from Scituate also on the 4th (WRP, SH), from GMNWR on the 15th (RKW, Martha's Vineyard (CBC), Tuckernuck (CBC) and 6 on Cape Cod (CBC). Totals of American Kestrels on CBC were: Boston-25, Cape Cod-31, Newburyport-22, and Plymouth-14.

GROUSE THROUGH SHOREBIRDS

Nineteen Ruffed Grouses were noted; the closest to Boston was a single bird in the Middlesex Fells (CBC-PMR). Bobwhite CBC totals include 65 in Buzzards Bay, 26 on Cape Cod, 49 in Plymouth, and 12 in Medfield.

A Clapper Rail was flushed from the marsh around East Boston on the 10th (RRV, SAP), and 2 were noted from WBWS, (CBC-WWB). Thirty-two Virginia Rails were noted, and a Sora was noted from GMNWR on the 22nd and 30th (RKW). A Common Gallinule was seen off and on at Horn Pond, Woburn, (fide GWG) and 2 were noted on the Nantucket CBC.

Forty-eight Killdeers were noted from 8 coastal locations during the month, and 1 was found in Northbridge on the 11th (NEM). Black-bellied

Plovers totaled 14 from the Quincy count, 55 on the Cape Cod CBC and 4 were noted on the Newburyport CBC. Twelve Ruddy Turnstones were found on the Nantucket CBC and 1 was noted on the Boston and Plymouth CBC's. An American Woodcock was found in Saugus on the 16th (AS), and 27 Common Snipes were reported throughout the month from 8 localities. A Willet (of the western race) was carefully noted on the 18th in Eastham (CBC-WRP, KSA#). The only recent December record is in 1974 where a Willet was present on Nauset from the 1st-7th. Two Greater Yellowlegs were found in E. Boston on the 10th (RRV#), and 1 was noted on the Quincy CBC and 2 on the Cape Cod CBC. Red Knots were present throughout the month in Scituate, with a high count of 20 on the 4th (SH, WRP); the Quincy count recorded 25, while the Plymouth CBC noted 32. High counts of Purple Sandpipers include 85 on the Boston CBC, 35 on the Nantucket CBC and 62 were found in Rockport on the 3rd (BBC, VA). Over 800 Dunlins were estimated from Scituate on the 4th (WRP, SH), while the counts in Quincy recorded 608, Boston-241 and Cape Cod noted 2672. Long-billed Dowitchers were reported from Newburyport on the 3rd when 3 were seen (RPE, WRP); a single bird was found on the 10th (PA) and 5 were carefully identified on the CBC there on the 26th (WRP#). Another adult Long-billed Dowitcher was found in Scituate on the 4th (WRP, SH). An unidentified dowitcher was observed on the 4th at Nauset (CAG, BN). A calidris (sp.?) sandpiper was noted from Newburyport on the 3rd (WRP, RPE). A Marbled Godwit was found in E. Boston on the 2nd (SZ); single Marbled Godwits were reported in December of 1973, 1974, and 1975 but all from Cape Cod. Sanderlings totaled 135 on the Nantucket CBC, 435 on the Boston CBC and 248 on the Plymouth CBC.

SKUAS THROUGH ALCIDS

A skua (sp.?) was noted off 1st Encounter on the 7th (BN, CAG). The only other skua reports in recent Decembers include 1 in Rockport in 1973 and 2 from Nantucket Shoals in 1976. Inland reports of Glaucous Gulls include 1 in Clinton on the 18th (HLM) and 2 were reported on the Worcester CBC on the 17th. Thirty Iceland Gulls were counted along Cape Ann on the 19th (CWL) and 23 were reported on the Newburyport CBC. Ring-billed Gull CBC totals include: 868 in Quincy, 302 in Boston, 290 on Cape Cod, and 136 in Newburyport. Black-headed Gulls continue in good numbers in the Boston Harbor area with 9 in E. Boston on the 10th (SAP, RRV), and 8 were found on the Quincy CBC; two adults were noted from Newburyport on the 3rd (WRP, RPE) and singles were found in Orleans, Nauset and E. Falmouth (CBC's). At Manomet over 1000 Bonaparte's Gulls were noted on the 8th (MBO) with a near 700 on the Tuckernuck CBC and over 500 on the Newburyport CBC. Wintering Laughing Gulls numbered 21 in the Revere-Winthrop area (BBC-RHS) early in the month with only 1-2 there by month's end; another single Laughing Gull was noted on the Plymouth CBC. In the Newburyport-Salisbury area 1-2 Little Gulls were present off and on during the month. The CBC totals for Black-legged Kittiwakes were: 820-Tuckernuck, 1201-Nantucket, and 1500-Cape Cod. A Forster's Tern was found in Newburyport on the 4th (WRP, RPE); other late occurrences were 12/4/68 when 2 were observed in Wellfleet, and more recently at Newburyport on 12/3/72 (RAF#). More startling was the record of a Common Tern on the 18th at Nantucket (CBC-John Dennis#). Only occasional stragglers remain into November with no records for December, and only one record for January (1/3/54).

At Cape Ann 125 alcids were moving along Andrews Point on the 19th, most

of which were thought to be Razorbills (CWL). As many as 4 Black Guillemots were found at Rockport during the month (v.o.), while 3 were noted from Ipswich on the 26th (CBC). A single Black Guillemot was found in Sandwich on the 21st (RFP).

OWLS THROUGH SWALLOWS

The Greater Boston CBC recorded 7 species of owls, with an additional species during count period. Highlights were 2 Barn Owls found in a chimney on Thompson's Island, 17 Screech, 5 Great Horned, 4 Barred, 2 Short-eared, and single Long-eared and Saw-whet Owls. A Snowy Owl was observed over Route 2 in Lexington on the 17th (JD'R), and another was seen in Byfield on the 25th (TJ). Barn Owls were also noted on the Martha's Vineyard and Cape Cod CBC and one was picked up dead in Rockport on the 17th (ON). The Newburyport CBC reported 13 Screech, 8 Great Horned Owls, and a Saw-whet Owl. Two Long-eared Owls were present off and on throughout the month (JMA), and 3 were noted on the Cape Cod CBC.

Eighteen Belted Kingfishers were reported from the Cape Cod CBC, while 8 on the Quincy CBC was the next highest maximum. The milder winter season on Cape Cod accounts for 115 Common Flickers on the Cape Cod CBC versus 15 on the Boston CBC. Red-headed Woodpeckers were reported from Gloucester most of the month (VA#+v.o.), from Weston on the 5th (LJR) and in Dover on the 12th-13th (Mrs. Kenneth King). Wintering Yellow-bellied Sapsuckers were reported from Chatham on the 11th (fide BN), at the Arnold Arboretum on the Boston CBC (HHD'E#) and on Nantucket on the 26th (CJ). Thirty Hairy Woodpeckers were recorded on the Boston CBC, while only 6 were noted on the Cape Cod CBC. A total of 148 Downy Woodpeckers were counted on the Boston CBC.

An empidonax flycatcher was found in Salem on the 3rd (RSH), establishing the latest record for an empidonax flycatcher in Massachusetts. Horned Larks totaled 228 on the Newburyport CBC, for a new high for that CBC. Four Tree Swallows were noted from south Plymouth on the 23rd (MBO staff).

BLUE JAYS THROUGH MIMIDS

The CBC totals for Blue Jays include 411 in Quincy, 1091 in Boston, 719 in Newburyport, 422 in Athol and 546 in Plymouth. The all-time high count for Blue Jays is 2,837 from Concord. A Common Crow roost in Waltham (LJR) contained an estimated 2,000 birds, while other roosts were noted from West Roxbury (RMB) and Natick (EWT); only a few Fish Crows were reported with 6 on the Boston CBC and 3-5 were noted from Weston (LJR). Black-capped Chickadee CBC totals were up from 1976; most notable was Newburyport with 770 reported as compared with only 199 last year. Other CBC totals included 811 in Boston, 672 in Athol, and 907 on Cape Cod. A Boreal Chickadee was noted in West Boylston on the 17th (BB) and another was present in Lexington from the 24th to the 26th (JWA). Tufted Titmice CBC totals include 122 in Quincy and 155 in Boston. White-breasted Nuthatch CBC totals were 106, Worcester; 171, Boston; 72 Newburyport, and 51 in Athol. The Red-breasted Nuthatch invasion of this past fall was still much in evidence with the CBC totals. The following chart indicates the totals for 1976 and 1977 for Red-breasted Nuthatches.

CBC	1976	1977
Athol	5	8
Boston	23	127
Newburyport	5	20
Quincy	2	12

In Weston, over 200 Red-breasted Nuthatches were counted on the 26th (LJR)

Twenty Brown Creepers were seen on the Boston CBC, one of which was taken by a Northern Shrike in the Middlesex Fells. In Newburyport 14 Brown Creepers were counted as compared with only 4 in 1976. House Wrens were reported from Orleans and on the 3rd (BN,CAG), in East Falmouth on the 17th (CAG), and singles on the Quincy and Plymouth CBC's for a total of 6 as compared with 0, 3, 0, 2, 1 for the last 5 years. In Melrose 1-2 Winter Wrens were present throughout the month (JWA+v.o.), while 2 were noted on the Plymouth CBC and singles on the Buzzards Bay, Cape Cod and Newburyport CBC's. Sixteen Carolina Wrens were noted on the Buzzards Bay CBC, they seem to be holding a steady population there since 18 were noted on that count last year. A total of 8 Long-billed Marsh Wrens were seen in Harwich on the 18th (CBC-BN) and 2 were seen in the Saugus Marsh on the Boston CBC, for an unusual winter record north of Boston (SZ,CJ).

Mockingbird CBC totals changed very little from 1976, with 59 in Quincy, 101 in Boston, 80 on Cape Cod, 39 in Newburyport and 51 in Plymouth. On Tuckernuck 6 Gray Catbirds were noted, and 5 were counted on the Nantucket CBC; the most northerly report was in Brookline on the 18th (CBC-DA). Eight Brown Thrashers were recorded from seven localities, most south of Boston.

THRUSHES THROUGH WARBLERS

American Robin CBC totals include 337 in Boston, 359 on Cape Cod and 52 at Newburyport. Certainly one of the highlights of the month was the mild invasion of Varied Thrush reports with singles reported from Brewster on the 5th (MLE), from Bedford on the 17th (LFoss), from Melrose on the 18th-31st (CBC-JNA+v.o.), from Ipswich on the 26th (HW#) and from West Concord on the 25th (VB#). Five Hermit Thrushes were reported with 1 in Boxford being the most northerly (CBC). In Chatham 7 Eastern Bluebirds were reported (HR#+v.o.) during the month.

Only 18 Golden-crowned Kinglets were reported during the month, the lowest number within the last five years for December. Ruby-crowned Kinglets however totaled 7 individuals, all from Plymouth south, showing no relationship with the scarcity of Golden-crowned Kinglets. Two Water Pipits were noted from Gloucester on the 3rd (BBC-VA) and a single pipit was noted from Revere on the 4th (RHS). Only small flocks of Cedar Waxwings were noted during the month with a maximum of only 75 on the Cape Cod CBC.

Northern Shrikes continued from November with 23+ reported during the month, while an adult Loggerhead Shrike was carefully studied in Canton on the 2nd (RMB). We are sorry to report that the Starling roosts are

still startling in Quincy and Boston with 100,000+ and 87,800+ respectively reported on the CBC.

There were 3 Orange-crowned Warblers reported with singles in Barnstable (RFP) on the 13th, Wareham on the 17th (CBC-WRP#) and in Chatham on the 18th (CBC-VS). Yellow-rumped Warbler CBC totals include 130, Quincy; 265 Tuckernuck; 227, Nantucket; 973, Cape Cod; 131, Plymouth; and 40 on PI. A Pine Warbler was found in Salem on the 3rd (IG), and Palm Warblers totaled 4 on the Cape Cod CBC, and 7 were seen in Bridgewater on the 27th (RSH). At Great Meadows, Concord, 1-2 Common Yellowthroats were present between the 8th-11th. Four Yellow-breasted Chats were noted during the month with singles in Salem on the 3rd (RSH), Scituate on the 4th (SH#), Falmouth on the 17th (CBC-VL) and 1 was noted in Waltham from the 1st-10th (PM).

MEADOWLARKS THROUGH SNOW BUNTINGS

As many as 65 Eastern Meadowlarks were counted in Bridgewater on the 26th (RSH), and 24 were reported on the Plymouth CBC. A few small wintering flocks of Redwinged Blackbirds were noted during the month with a maximum of just 40 on the Nantucket CBC. A number of Northern Orioles were wintering in different areas of eastern Massachusetts as summarized below:

Northern Orioles:

8, 10	Wayland, Ipswich	1, 1	J.Santamaria, JN
15, 18	Canton, Chatham	1, 1	R.Michener, CBC-BN
20, 31	Wayland (different), Rockland	1, 1	H.Chamberlin, fide MJL

Two Rusty Blackbirds were noted at GMNWR on the 16th (RKW), 3 were reported on the Boston CBC, and 2 on the Buzzards Bay CBC. A wintering flock of Common Grackles totaled 150+ in Dedham on the 27th-28th (EC), and a flock of 100 Brown-headed Cowbirds were noted from Littleton on the 4th (JB). Western Tanagers were reported from Nantucket on the 4th-5th (JD), from Manomet on the 13th (MBO staff), and one was picked up dead on the 27th (NH) in Belmont--specimen to MAS. In Boston 141 Cardinals were counted on the CBC, 108 were noted on the Cape Cod CBC and 44 were reported on the Newburyport CBC. An Indigo Bunting was reported from Nantucket (fide EFA) on the 18th for an extremely late record. The only other winter record is from Billerica on 2/22/53 where it remained until 4/14/53. Dickcissels were noted from Truro on the 4th (RMB#) and from Canton on the 26th (BBlakely). Evening Grosbeak totals were not quite as high along the coast as they were inland with Athol reporting 937. Only 3 Purple Finches were reported on the Quincy CBC, while 44 were noted on the nearby Boston CBC. House Finches continue to increase; while not so evident in Greater Boston and Cape Cod, other areas show a marked increase since 1972. Below is a 1972 and 1977 comparison for House Finches.

CBC	1972	1977
Cape Cod	489	462
Greater Boston	139	155
Nantucket	0	86
Newburyport	15	59
Quincy	41	111

As many as 85 Pine Grosbeaks were reported between the 17-31st from 9 localities. Common Redpolls arrived in good numbers at mid-month with 71 on the Worcester CBC, 139 reported on the Boston CBC, and 176 on the Athol CBC. Pine Siskins continued in exceptional numbers and CBC totals include: 122, Worcester; 272, Cape Cod; 487,Boston; 175, Newburyport; and 314 in Athol. The CBC totals for American Goldfinches were normal with 452 in Boston; 318, Cape Cod; 254, Newburyport and 134 in Plymouth. Red Crossbills totaled 36 on the Newburyport CBC and 108 on the Plymouth CBC. The number of White-winged Crossbills continued to increase with 191 reported on the Boston CBC and 199 on the Worcester CBC. Wintering Rufous-sided Towhees include the following CBC totals: Boston, 4; Nantucket, 4; and Plymouth, 3.

On Plymouth Beach 4 "Ipswich Sparrows" were noted on the CBC (TL'D). Two Sharp-tailed Sparrows and 1 Seaside Sparrow were noted at Nauset on the 18th (CBC-WRP); another Sharp-tailed Sparrow was seen in E. Boston on the 10th (RRV#). A Lark Sparrow visited a feeder in Needham on the 5th where it remained through the end of the month (DHottle +v.o.). Dark-eyed Junco CBC totals include: 138, Quincy; 734, Boston; 182, Newburyport; and 268 in Plymouth. High counts of Tree Sparrows include 492 in Newburyport and 361 in Boston CBC's. A Chipping Sparrow was noted in the Barnstable-Sandwich area on the 8th (RFP). Eleven Field Sparrows were noted on both the Quincy and Plymouth CBC's, and 6 were noted from Weston on the 17th (LJR). The sparrow highlight was an immature first winter Harris' Sparrow found in Belmont on the 16th where it remained until the 24th (PM+v.o.). For the 2nd year in a row the Nantucket CBC recorded 12 White-crowned Sparrows; 3 adults were noted from Danvers on the 23rd (RSH) and singles were noted in Stoneham (MM) and on the Boston and Tuckernuck CBC's. White-throated Sparrows were way down from 1976 records as summarized below:

CBC	1976	1977
Cape Cod	485	112
Greater Boston	472	185
Newburyport	153	45
Plymouth	489	93

Twenty-two Fox Sparrows were noted on the Boston CBC and 23 others were recorded from 10 localities. In Lancaster 4 Swamp Sparrows were found from the 18th on (HLM) and 2 were noted on the Newburyport CBC. The totals of Song Sparrows were also down from last year, with 50 in Quincy; 55, Tuckernuck; 203, Boston; 56, Newburyport; and 97 in Plymouth. Lapland Longspurs totaled 40 in Salisbury on the CBC as the month's maximum. On Martha's Vineyard 150 Snow Buntings were found on the CBC and 41 were noted in Framingham on the 25th-26th (RAF).

R. H. S.

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ADDENDA

November 1977

Red-breasted Merganser:	11/12	Barnstable	4,700	RFP
Red-shouldered Hawk:	11/16	Brewster	1	CAG
Red Phalarope:	11/11	F.E.	4	WB
Forster's Tern:	11/15	Barnstable	1	RFP
Caspian Tern:	11/3	Eastham	9	CAG
Barn Owl:	11/3	East Orleans (severely injured-later died)	1	R.Prescott
	11/25	Hyannis	1	VL
Barn Swallow:	11/12	Orleans	1	BN,CAG
Western Kingbird:	11/10	Eastham	1	CAG
Lincoln's Sparrow:	11/6	Wellfleet	1	BN

BIRD SIGHTINGS ON PARKER RIVER REFUGE

Starting immediately "Interesting Observations" sheets will be maintained at the Parker River National Wildlife Refuge (Plum Island). The sheets will be on a clipboard located inside the gatehouse on the western wall at the main entrance to the Refuge.

The personnel would like you to feel free to stop and use these sheets at any time. Even when the gatehouse is unattended, the door is open to allow you to refer to the listings of bird sightings or to record listings of your own observations.

TIDE CHART

Here is the tide table for Boston Harbor; add one hour for Daylight Savings Time.

1978 MAY TIDES 1978

Morning		BOSTON	Afternoon	
High	11.21	SUNDAY 7 ● NEW MOON	High	11.34
Height	9.6		Height	10.5
Low	5.07		Low	5.19
Height	-0.9		Height	-0.1
Sunrise	4.30		Sunset	6.51
High	—	MONDAY 8	High	12.03
Height	—		Height	9.5
Low	5.49		Low	6.01
Height	-0.8		Height	0.1
Sunrise	4.29		Sunset	6.52
High	12.15	TUESDAY 9	High	12.44
Height	10.3		Height	9.3
Low	6.30		Low	6.42
Height	-0.6		Height	0.4
Sunrise	4.28		Sunset	6.53
High	12.55	WEDNESDAY 10	High	1.26
Height	10.1		Height	9.0
Low	7.11		Low	7.23
Height	-0.4		Height	0.7
Sunrise	4.27		Sunset	6.54
High	1.37	THURSDAY 11	High	2.09
Height	9.8		Height	8.8
Low	7.55		Low	8.07
Height	-0.1		Height	0.9
Sunrise	4.25		Sunset	6.55
High	2.20	FRIDAY 12	High	2.54
Height	9.3		Height	8.6
Low	8.38		Low	8.54
Height	-0.2		Height	1.2
Sunrise	4.25		Sunset	6.56
High	3.05	SATURDAY 13	High	3.42
Height	9.2		Height	8.4
Low	9.26		Low	9.44
Height	0.5		Height	1.4
Sunrise	4.23		Sunset	6.58

BOSTON Eastern Standard Time — MAY — Add 1 Hour for Daylight Savings Time — BOSTON

Morning		BOSTON	Afternoon	
High	3.55	SUNDAY 14	High	4.31
Height	8.9		Height	8.4
Low	10.15		Low	10.36
Height	0.7		Height	1.5
Sunrise	4.22		Sunset	6.59
High	4.47	MONDAY 15 ◗ FIRST QUARTER	High	5.22
Height	8.8		Height	8.5
Low	11.06		Low	11.32
Height	0.8		Height	1.4
Sunrise	4.21		Sunset	7.00
High	5.41	TUESDAY 16	High	6.14
Height	8.7		Height	8.7
Low	11.59		Low	—
Height	0.8		Height	—
Sunrise	4.20		Sunset	7.01
High	6.33	WEDNESDAY 17	High	7.04
Height	8.8		Height	9.1
Low	12.27		Low	12.50
Height	1.2		Height	0.6
Sunrise	4.19		Sunset	7.02
High	7.27	THURSDAY 18	High	7.52
Height	9.0		Height	9.6
Low	1.19		Low	1.41
Height	0.7		Height	0.4
Sunrise	4.19		Sunset	7.03
High	8.18	FRIDAY 19	High	8.41
Height	9.3		Height	10.2
Low	2.10		Low	2.29
Height	0.1		Height	0.1
Sunrise	4.18		Sunset	7.04
High	9.09	SATURDAY 20	High	9.27
Height	9.6		Height	10.7
Low	3.01		Low	3.16
Height	-0.5		Height	-0.2
Sunrise	4.17		Sunset	7.04

BOSTON Eastern Standard Time — MAY — Add 1 Hour for Daylight Savings Time — BOSTON

1978 JUNE TIDES 1978

Morning		BOSTON	Afternoon	
High	10.17	SUNDAY 4	High	10.28
Height	9.1		Height	10.3
Low	4.03		Low	4.12
Height	-0.4		Height	0.3
Sunrise	4.08		Sunset	7.16
High	11.00	MONDAY 5 ● NEW MOON	High	11.09
Height	9.1		Height	10.2
Low	4.45		Low	4.54
Height	-0.5		Height	0.4
Sunrise	4.07		Sunset	7.18
High	11.41	TUESDAY 6	High	11.47
Height	9.1		Height	10.1
Low	5.26		Low	5.33
Height	-0.5		Height	0.5
Sunrise	4.07		Sunset	7.18
High	—	WEDNESDAY 7	High	12.19
Height	—		Height	9.0
Low	6.05		Low	6.15
Height	-0.4		Height	0.6
Sunrise	4.07		Sunset	7.18
High	12.28	THURSDAY 8	High	1.00
Height	10.0		Height	8.9
Low	6.47		Low	6.57
Height	-0.3		Height	0.8
Sunrise	4.06		Sunset	7.20
High	1.08	FRIDAY 9	High	1.42
Height	9.8		Height	8.8
Low	7.27		Low	7.40
Height	-0.2		Height	0.9
Sunrise	4.06		Sunset	7.21
High	1.51	SATURDAY 10	High	2.23
Height	9.6		Height	8.8
Low	8.09		Low	8.23
Height	0.0		Height	1.1
Sunrise	4.06		Sunset	7.21

BOSTON Eastern Standard Time — JUNE — Add 1 Hour for Daylight Savings Time — BOSTON

Morning		BOSTON	Afternoon	
High	2.34	SUNDAY 11	High	3.08
Height	9.4		Height	8.7
Low	8.52		Low	9.10
Height	0.2		Height	1.2
Sunrise	4.06		Sunset	7.22
High	3.21	MONDAY 12	High	3.55
Height	9.3		Height	8.8
Low	9.39		Low	10.00
Height	0.4		Height	1.2
Sunrise	4.06		Sunset	7.22
High	4.08	TUESDAY 13 ◗ FIRST QUARTER	High	4.43
Height	9.0		Height	8.9
Low	10.27		Low	10.52
Height	0.5		Height	1.2
Sunrise	4.06		Sunset	7.22
High	5.02	WEDNESDAY 14	High	5.31
Height	8.8		Height	9.1
Low	11.16		Low	11.48
Height	0.6		Height	0.9
Sunrise	4.06		Sunset	7.22
High	5.54	THURSDAY 15	High	6.23
Height	8.8		Height	9.5
Low	—		Low	12.07
Height	—		Height	0.6
Sunrise	4.06		Sunset	7.23
High	6.48	FRIDAY 16	High	7.13
Height	8.9		Height	9.9
Low	12.41		Low	1.02
Height	0.5		Height	0.4
Sunrise	4.06		Sunset	7.23
High	7.44	SATURDAY 17	High	8.07
Height	9.3		Height	10.5
Low	1.36		Low	1.54
Height	0.0		Height	0.1
Sunrise	4.07		Sunset	7.24

BOSTON Eastern Standard Time — JUNE — Add 1 Hour for Daylight Savings Time — BOSTON

1978 MAY JUNE TIDES 1978

Morning		BOSTON	Afternoon	
High	10.00	SUNDAY 21	High	10.16
Height	9.9		Height	11.2
Low	3.49		Low	4.04
Height	-1.1		Height	-0.6
Sunrise	4.17		Sunset	7.04
High	10.47	MONDAY 22 ○ FULL MOON	High	11.05
Height	10.2		Height	11.6
Low	4.38		Low	4.52
Height	-1.6		Height	-0.8
Sunrise	4.17		Sunset	7.04
High	11.39	TUESDAY 23	High	11.55
Height	10.4		Height	11.7
Low	5.28		Low	5.42
Height	-1.9		Height	-0.9
Sunrise	4.16		Sunset	7.05
High	—	WEDNESDAY 24	High	12.30
Height	—		Height	10.4
Low	6.18		Low	6.32
Height	-2.0		Height	-0.9
Sunrise	4.16		Sunset	7.06
High	12.46	THURSDAY 25	High	1.23
Height	11.7		Height	10.4
Low	7.08		Low	7.25
Height	-2.0		Height	-0.7
Sunrise	4.14		Sunset	7.06
High	1.40	FRIDAY 26	High	2.19
Height	11.5		Height	10.2
Low	8.01		Low	8.20
Height	-1.7		Height	-0.4
Sunrise	4.14		Sunset	7.08
High	2.36	SATURDAY 27	High	3.15
Height	11.1		Height	10.0
Low	8.57		Low	9.20
Height	-1.4		Height	-0.1
Sunrise	4.13		Sunset	7.09

BOSTON Eastern Standard Time — MAY — Add 1 Hour for Daylight Savings Time — BOSTON

Morning		BOSTON	Afternoon	
High	3.34	SUNDAY 28	High	4.16
Height	10.6		Height	9.9
Low	9.55		Low	10.22
Height	-0.9		Height	0.1
Sunrise	4.13		Sunset	7.10
High	4.37	MONDAY 29 ◔ LAST QUARTER	High	5.16
Height	10.1		Height	9.8
Low	10.55		Low	11.25
Height	-0.5		Height	0.2
Sunrise	4.12		Sunset	7.10
High	5.39	TUESDAY 30	High	6.17
Height	9.7		Height	9.9
Low	11.54		Low	—
Height	-0.2		Height	—
Sunrise	4.11		Sunset	7.11
High	6.41	WEDNESDAY 31	High	7.14
Height	9.3		Height	10.0
Low	12.28		Low	12.54
Height	0.2		Height	0.0
Sunrise	4.10		Sunset	7.13
High	7.42	THURSDAY 1	High	8.09
Height	9.3		Height	10.1
Low	1.31		Low	1.49
Height	0.1		Height	0.1
Sunrise	4.10		Sunset	7.14
High	8.39	FRIDAY 2	High	8.59
Height	9.2		Height	10.2
Low	2.27		Low	2.40
Height	-0.1		Height	0.2
Sunrise	4.08		Sunset	7.15
High	9.30	SATURDAY 3	High	9.46
Height	9.2		Height	10.3
Low	3.17		Low	3.28
Height	-0.3		Height	0.3
Sunrise	4.08		Sunset	7.16

BOSTON Eastern Standard Time — MAY-JUNE — Add 1 Hour for Daylight Savings Time — BOSTON

1978 JUNE-JULY TIDES 1978

Morning		BOSTON	Afternoon	
High	8.39	SUNDAY 18	High	8.58
Height	9.5		Height	11.0
Low	2.31		Low	2.45
Height	-0.6		Height	-0.2
Sunrise	4.07		Sunset	7.24
High	9.32	MONDAY 19	High	9.51
Height	9.8		Height	11.5
Low	3.24		Low	3.38
Height	-1.3		Height	-0.5
Sunrise	4.07		Sunset	7.24
High	10.26	TUESDAY 20 ○ FULL MOON	High	10.44
Height	10.2		Height	11.8
Low	4.16		Low	4.29
Height	-1.7		Height	-0.8
Sunrise	4.07		Sunset	7.24
High	11.19	WEDNESDAY 21	High	11.36
Height	10.6		Height	12.0
Low	5.07		Low	5.21
Height	-2.0		Height	-1.0
Sunrise	4.07		Sunset	7.24
High	—	THURSDAY 22	High	12.12
Height	—		Height	10.6
Low	5.58		Low	6.15
Height	-2.2		Height	-1.1
Sunrise	4.08		Sunset	7.25
High	12.29	FRIDAY 23	High	1.06
Height	11.9		Height	10.6
Low	6.50		Low	7.08
Height	-2.3		Height	-1.0
Sunrise	4.08		Sunset	7.25
High	1.24	SATURDAY 24	High	2.01
Height	11.7		Height	10.6
Low	7.43		Low	8.04
Height	-1.9		Height	-0.7
Sunrise	4.08		Sunset	7.25

BOSTON Eastern Standard Time — JUNE — Add 1 Hour for Daylight Savings Time — BOSTON

Morning		BOSTON	Afternoon	
High	2.20	SUNDAY 25	High	2.56
Height	11.2		Height	10.4
Low	8.38		Low	9.02
Height	-1.5		Height	-0.4
Sunrise	4.09		Sunset	7.25
High	3.18	MONDAY 26	High	3.53
Height	10.7		Height	10.2
Low	9.33		Low	10.01
Height	-1.0		Height	-0.1
Sunrise	4.09		Sunset	7.25
High	4.16	TUESDAY 27 ◔ LAST QUARTER	High	4.52
Height	10.1		Height	10.1
Low	10.30		Low	11.03
Height	-0.5		Height	0.1
Sunrise	4.10		Sunset	7.25
High	5.16	WEDNESDAY 28	High	5.49
Height	9.5		Height	9.9
Low	11.28		Low	—
Height	0.0		Height	—
Sunrise	4.10		Sunset	7.25
High	6.17	THURSDAY 29	High	6.48
Height	9.1		Height	9.9
Low	12.05		Low	12.25
Height	0.3		Height	0.3
Sunrise	4.11		Sunset	7.25
High	7.17	FRIDAY 30	High	7.40
Height	8.8		Height	9.9
Low	1.07		Low	1.21
Height	0.3		Height	0.6
Sunrise	4.11		Sunset	7.25
High	8.14	SATURDAY 1	High	8.31
Height	8.7		Height	9.9
Low	2.03		Low	2.12
Height	0.2		Height	0.7
Sunrise	4.12		Sunset	7.24

BOSTON Eastern Standard Time — JUNE-JULY — Add 1 Hour for Daylight Savings Time — BOSTON

Tidal differences from Boston High Tide

Newburyport	31 minutes later
Scituate	5 minutes earlier
Plymouth	5 minutes later
Chatham (outside)	30 minutes later
(inside)	(1 hr) 54 minutes later
New Bedford	(3 hrs) 15 minutes earlier

BIRD OBSERVER
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Belmont, Mass. 02178

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