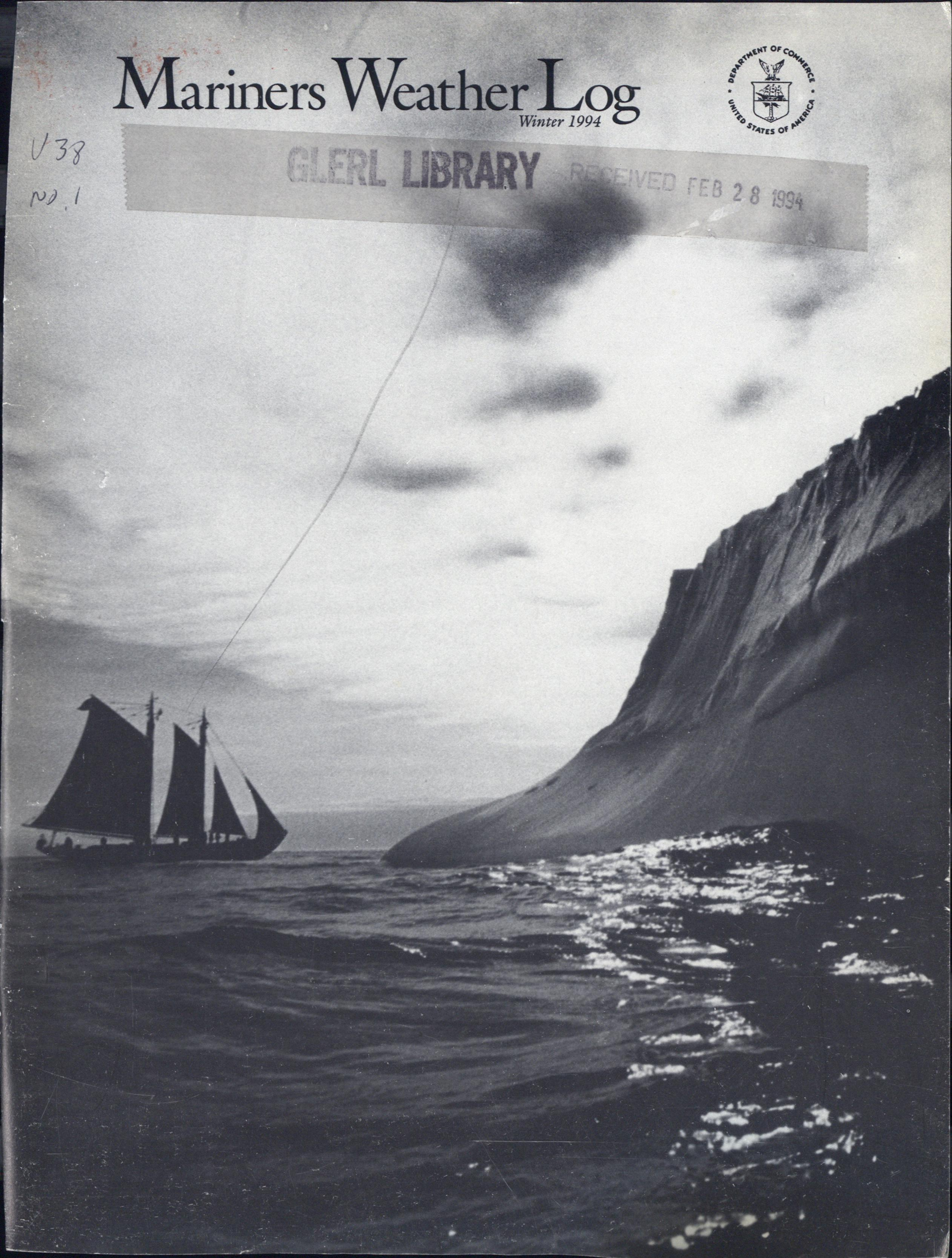
Mariners Weather Log

Winter 1994

DEPARTMENT OF COMMERCE
UNITED STATES OF AMERICA



Old Mackinac Point Lighthouse

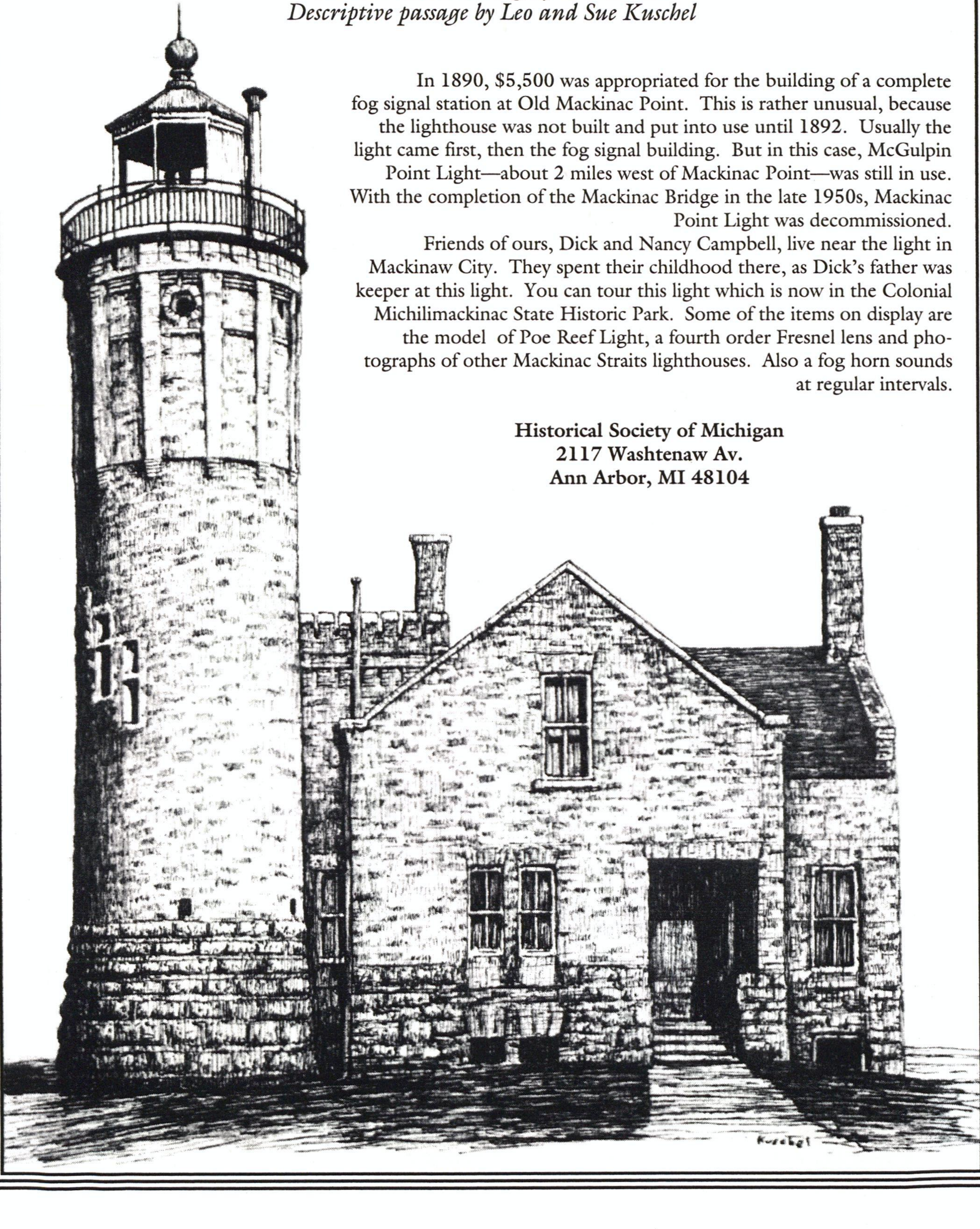
Lake Huron
Mackinaw City, Michigan

Pen and Ink Drawing by Leo Kuschel
Descriptive passage by Leo and Sue Kuschel

In 1890, $5,500 was appropriated for the building of a complete fog signal station at Old Mackinac Point. This is rather unusual, because the lighthouse was not built and put into use until 1892. Usually the light came first, then the fog signal building. But in this case, McGulpin Point Light—about 2 miles west of Mackinac Point—was still in use. With the completion of the Mackinac Bridge in the late 1950s, Mackinac Point Light was decommissioned.

Friends of ours, Dick and Nancy Campbell, live near the light in Mackinaw City. They spent their childhood there, as Dick's father was keeper at this light. You can tour this light which is now in the Colonial Michilimackinac State Historic Park. Some of the items on display are the model of Poe Reef Light, a fourth order Fresnel lens and photographs of other Mackinac Straits lighthouses. Also a fog horn sounds at regular intervals.

Historical Society of Michigan
2117 Washtenaw Av.
Ann Arbor, MI 48104



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Vol. 38, No. 1

Cover: The training schooner ***Bowdoin*** operated and cared for by Maine Maritime Academy approaches an iceberg while voyaging to Disco Island, Greenland. Photograph by Tom Stewart.

Inside Back Cover: Hurricane Emily generated some problems at sea and posed a mighty threat to the U.S. East Coast in 1993. Photograph courtesy of George Stephens of NESDIS.

Back Cover: Beautiful but dangerous— moonlit icebergs drifting along in the Labrador Current. Photograph by Philip Dattilo.

Castle Head, Mount Desert, Maine— page 4

Departments

Marine Weather Review
July, August and September 1993

Mariners Weather Log

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through July l, 1994.

The ***Mariners Weather Log*** (ISSN:0025-3367) is published quarterly by the **National Oceanographic Data Center**, National Environmental Satellite, Data, and Information Service, NOAA, Washington DC 20235 (telephone: 202-606-4561). Funding is provided by the National Weather Service, NOAA. Data is provided by the **National Climatic Data Center**, NOAA.

Articles, photographs and letters should be sent to:

Editor, Mariners Weather Log
National Oceanographic Data Center
1825 Conn. Av., NW
Washington DC 20235.

Missing Observations

To a mariner few things would be as frustrating as taking the time to take and transmit a weather observation and then feel that it hasn't even gotten into the system. Many ship captains and marine observers have asked why the weather observations aboard their ships are not listed in the "U.S. VOS Weather Reports" section of the Mariners Weather Log. The answers are often complex, and solutions are evasive. Ship weather observations audited for this report come from two sources: radio transmissions collected via the Global Telecommunications Systems (GTS) by the National Meteorological Center (NMC) and transferred to the National Climatic Data Center (NCDC), and ship weather log forms received by mail at NCDC either from PMOs or directly from ships or shipping companies. The radio-transmitted observations can be lost or garbled in the hugely complex telecommunication system and thus never reach NCDC. The manuscript forms are collected and digitized at NCDC about 45 days after the end of each data-month. For example, the observations taken during December 1993 will generally be digitized in late February 1994. However, the forms are sometimes delayed in transit and not received until several months after the voyage and sometimes are lost completely. Approximately 20% of the observations are received too late to be included in the quarterly report.

Once the manuscript observations are digitized, they are rematched with the radio observation received via GTS. During the matching process, only the observations at NCDC by the cut-off time can be processed for any given data-month. Delayed observations cannot be counted since they are processed after the report is published. The published number of radio and mail observations received at NCDC are identified by the ship's international radio call sign. If the computer table of call sign, ship name and responsible PMO is not up to date (as can happen with a recent change), or if the call sign is missing, garbled, or miskeyed, the observation count may not appear on the list or may be assigned to an incorrect ship identifier. And, the practice of matching call signs has one serious weakness. Observations received via GTS do not carry call signs past the sixth character. Therefore, any valid call sign of seven characters carried by GTS will not be included in the report. This is especially critical on the Great Lakes.

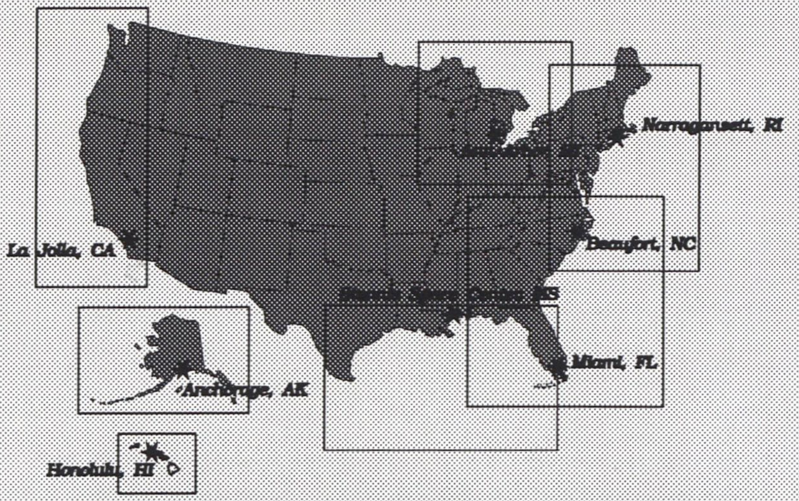
To improve the chance that your observations are counted, first ensure that the correct call sign is transmitted as well as entered legibly together with ship name on the observation form. Mail the observation forms to a Port Meteorological Officer or directly to NCDC as soon you hit port.

Your ship observations are of vital importance to many forecasting and climate programs. They are sea-truth information for satellites and barometers of global change. Our thanks to all marine observers, past and present, who have contributed so much through weather observations.

--Rob Quayle, Joe Elms and Wilbur Biggs
National Climatic Data Center
Asheville, NC 28801

NOAA CoastWatch

Information Flyer



Regional Nodes and Sites

Who? What? Where?

With support from the NOAA Coastal Ocean Program, in conjunction with NOAA Line Offices, NOAA's CoastWatch Program delivers satellite data products and in-situ data to Federal, state, and local marine scientists and coastal resource managers.

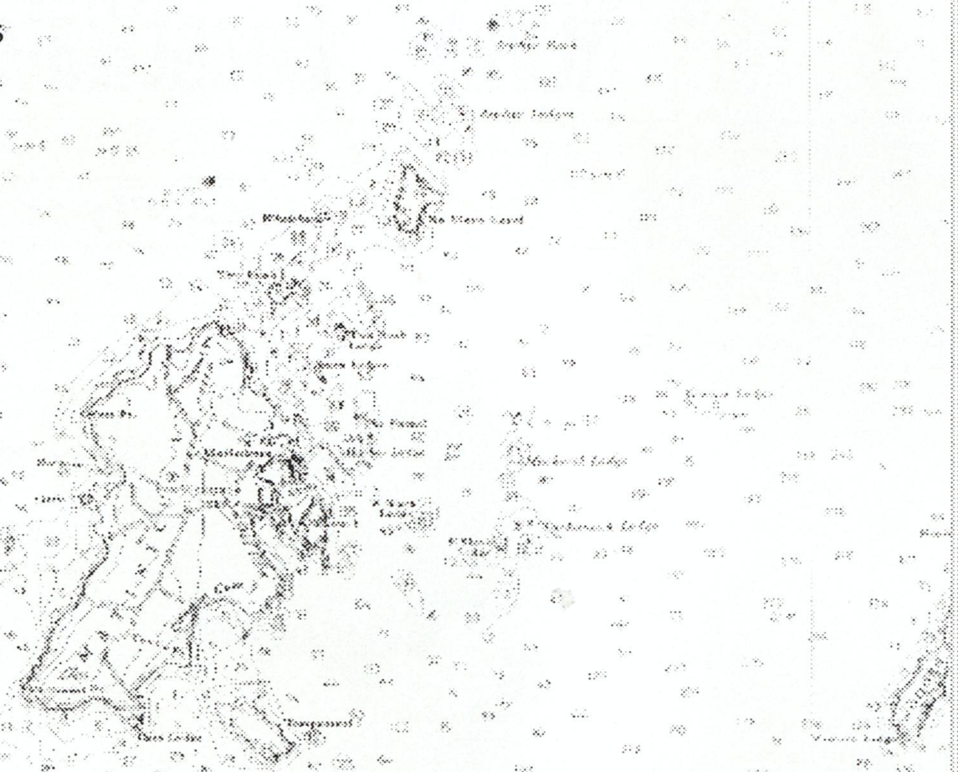
For coastal areas in the Great Lakes, East Coast and Gulf of Mexico, data from the Advanced Very High Resolution Radiometer (AVHRR) on NOAA's polar orbiting spacecraft are collected at Wallops Island, MD and at Fairbanks, AK . These data are processed on NOAA/NESDIS mainframe computers in Suitland, MD using a set of NOAA-developed multi-channel atmospherically corrected algorithms for determination of sea surface temperature. Data are then mapped and sectorized to predefined coordinates specified for each of the CoastWatch regions. Digital, high resolution data products covering the entire coastline of the conterminous U.S., Alaska and Hawaii are then passed through NOAA's National Ocean Service Ocean Products Center and on to five CoastWatch Regional Nodes in the eastern U.S. (ie., Southeast, Great Lakes, Northeast, Gulf of Mexico, and Caribbean). The nationally distributed Internet is used as the primary telecommunications pathway for digital data distribution. Once data are delivered to the CoastWatch Regional Nodes they become available for local use to state, local, and federal marine scientists and decision makers. An ever growing number of Federal, state, and local organizations are establishing a formal relationship with their local CoastWatch Regional Node for routine timely access to CoastWatch image products. For coastal areas in the western United States, CoastWatch relies on local data acquisition and processing capabilities in La Jolla, Anchorage, and Honolulu. These regions's local access to sea surface temperatures is roughly equivalent to that of Nodes in the east. Retrospective availability of CoastWatch data products is presently supported through a remotely accessible (dial-up, or Internet), near-line system at the National Oceanographic Data Center, Washington, D.C. NOAA's National Environmental Satellite, Data, and Information Service has responsibility for CoastWatch Program Management.

December, 1993

(See page 15 for CoastWatch Regional Sites)

They'll Never Find Us

Margot M. McWilliams



Rudy Musetti shivered as he re-entered the wheelhouse after a quick inspection of the *Harkness*, the 70-foot tugboat he captained. The vessel was chugging through one of the worst gales Musetti had seen in his 37 years on the treacherous North Atlantic. It was 5:30 P.M. on January 16, 1992, and as he settled in to steer, he knew it would be a long night.

That morning the seas had been peaceful when the *Harkness* left Eliot, at the southern tip of Maine, for the 22-hour voyage up to its home berth in Northeast Harbor, on Mount Desert Island. But the weather had suddenly changed. Now the thermometer registered 4°F, the wind was blowing at 40 knots, seas were swelling from 10 to 15 feet, and every inch of the tug's exterior was covered with ice. A 6-foot layer of sea smoke, an impenetrable vapor created by the difference between ocean and air temperatures, floated on the water's surface.

The *Harkness* was travelling 25 miles offshore to avoid the maze of islands closer in. There were no fishing boats this far out after dark, especially in these conditions. Musetti's only contact with shore was via his VHF radio. Confident he could bring the *Harkness* to a safe mooring, the 57-year-old captain radioed ahead to Northeast Harbor just before 6 P.M.: "Our ETA is 5 A.M. tomorrow—as scheduled."

Ship's mate Arthur Stevens, 43, poured hot coffee for Musetti and passenger Duane Cleaves, 54, a potato-farmer friend who had come along for the ride. The sounds of amiable conversation competed with the raging winds outside. Cleaves and Stevens had full confidence in their captain. Along the rugged Maine coast, Musetti was respected as a man who never gave up once he set out to do something.

As the chill began to leave Musetti's bones, he turned and cast a watchful eye back over the length of the tug— and couldn't believe what he saw.

Margot McWilliams describes the sinking of the ***Harkness*** as an "incredible story" she had to write. A resident of Portland, Maine, McWilliams frequently visits Matinicus Island, the scene of this dramatic rescue. She also writes a weekly arts column for the ***Casco Bay Weekly***. Reprinted with permission from the October 1993 Reader's Digest.

More than a foot of water was sloshing around the deck. *Where did that come from?* Musetti wondered. *Could the boat have split a hull seam?*

He started the bilge pump and kept his eyes locked on the stern. The water was still rising. With a sinking heart, he soon knew the pump had frozen.

At that moment the tug took a swell broadside, and the two 500-foot coils of tow rope stowed on the stern washed overboard. Musetti knew the ***Harkness*** would have to keep moving and stay straight or those hawsers would snarl the propellers and kill the engines.

"We've got a problem, boys," he said and radioed the Coast Guard. "I've got a foot and a half of water on the stern, and it's coming on fast. I'm going to try for Frenchboro," he said, referring to a port 20 miles to the north.

"Forget Frenchboro," a voice came back. "You'll never make it. Try for Matinicus."

Matinicus? Musetti thought as he replaced the mike on the hook. *Is anyone on that God-forsaken rock in the winter?*

A little before six o'clock, Rick and Sue Kohls arrived for a lasagna dinner with their neighbors, Vance and Sari Bunker. With virtually no ferry service to the mainland, the 10 families that lived and lobster-fished year-round on Matinicus Island had to rely on one another. One of their unwritten laws was to help anyone in trouble, particularly anyone at sea.

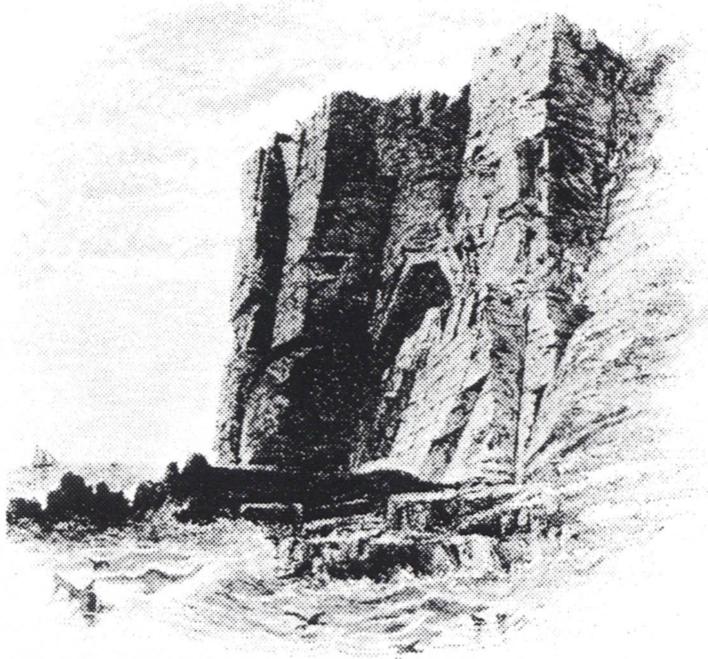
That evening when the Kohlses and Bunkers settled down to eat, the ever-present VHF radio crackled in the background. Soon the four friends heard Rudy Musetti's exchange with the Coast Guard. They listened, disbelieving, as Musetti reported his location and the depth of water over his stern. Then they heard him being urged to try for Matinicus.

Vance Bunker got up from the table and opened the porch door. The thermometer read six below. He listened to the wind and felt its savage bite. When he came back into the room, barely a word was spoken. As the men suited up in their foul-weather gear, they placed a call to island electrician Paul Murray to join them on the ***Jan-Ellen***, the Bunkers' boat. *We don't have a chance of reaching them in time,* Vance thought. But he knew they had to try.

Musetti struggled with the idea of heading for Matinicus. Every instinct was telling him to stay on course and head for a place he knew. *If we change course,* he thought, *we're going to run afoul of the hawsers.*

The Coast Guard had radioed that a cutter was en route from Rockland. But Musetti was sure it couldn't reach them in time. *I have no choice,* he told himself as he turned the wheel toward Matinicus.

Then, sure enough, two-thirds of the way into the turn, the loose hawsers swept under the boat and like deadly snakes wrapped themselves around both propellers, killing the engines. The ***Harkness*** was adrift, dead in the water. All that could be heard now was the triumphant howl of the wind.



Heading home— Castle Head, Mount Desert

A few minutes later, at 6:40, Musetti picked up a voice on his radio. "This is the ***Jan-Ellen*** from Matinicus," Vance Bunker said. "We're on our way." *But can you get here in time?* Musetti thought grimly.

As the ***Jan-Ellen*** cleared the Matinicus breakwater, icing-up began. Bunker had never seen spray freeze as hard and as fast. When the boat left the harbor shortly before 7 P.M., Musetti had given his position over the radio and warned Bunker about the loose hawsers. If they got tangled in the ***Jan-Ellen***'s propeller and the ***Harkness*** sank, Bunker's much smaller boat would be pulled down with it.

Along the coast of Maine, families were now glued to their VHF sets, listening to the drama unfolding on the seas. Soon they heard another frightening message. "It's up to our chests in the wheelhouse," Musetti reported. "We're going down." After that, there was silence.

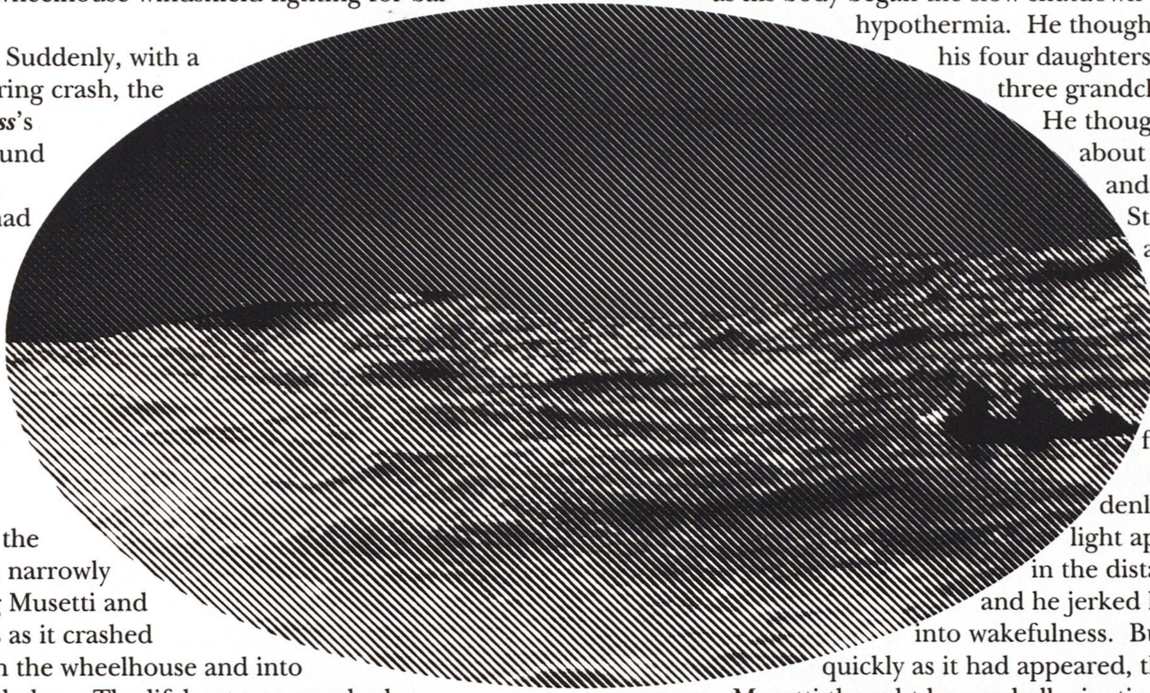
Bunker knew now that the three of them were risking their lives for what were likely to be dead men. Survival time in these water in January is usually measured in minutes. Still, he kept the ***Jan-Ellen*** moving ahead, as Kohls and Murray peered blindly into the sea smoke.

Inside the ***Harkness***'s swamped wheelhouse, while Musetti talked to the Coast Guard on the radio, Duane Cleves struggled to guide the captain's feet into one of the thinly insulated immersion suits that had been stowed on board. Musetti knew that the suits, designed to protect deck workers from the initial shock of cold water if they fell overboard, wouldn't keep them warm for long. Yet this was all they had.

On the roof of the wheelhouse, Steven was having trouble freeing an inflatable life raft from its protective canister. Cleaves pointed to the dinghy lashed to the bow and volunteered to climb over to it, but Musetti dismissed the idea, noting that their chances of survival would be greater if they stuck together. Cleaves grabbed a flashlight from the cabinet near the tug's wheel and went to the roof to help Stevens.

When the life raft wouldn't inflate, Cleaves yelled for the captain. By the time Musetti made it up to the roof, the tug's bow was pointing straight up at a 90° angle to the water. The men were now standing on the wheelhouse windshield fighting for balance.

Suddenly, with a shuddering crash, the ***Harkness***'s 500-pound anchor, which had been at rest on the point of the bow, thundered down toward the dinghy, narrowly missing Musetti and Cleaves as it crashed through the wheelhouse and into the sea below. The lifeboat was smashed.



Musetti realized if they were not some distance from the ***Harkness*** when it sank, suction would pull them right down with the tug. Before he could say a word, a wave washed over the boat and swept all three men into the water.

Musetti gasped as the paralyzing water sucked the air out of his lungs. While his ship slid silently into the water, he felt sick.

"Rudy, Rudy, over here!" he heard through the deafening wind. Cleaves and Stevens were calling him. They were holding on to an 8-foot wooden ladder that had somehow freed itself from the deck and floated right over to Cleaves, who couldn't swim. He grabbed it, then Stevens and now Musetti.

"Good. We're together," Musetti said. "If we drift apart, they'll never find us." *They'll never find us anyway*, he thought. But he had to keep up the other men's courage.

Fifteen minutes later, the ***Jan-Ellen*** arrived at the last coordinates the ***Harkness*** had given. As expected, there was nothing there but the howling wind and the blackness. Suddenly a light pierced the sea smoke. "There she is, there she is!" Bunker yelled at Kohls and Murray.

Quickly he realized his mistake. The light was not from the ***Harkness,*** but from the Coast Guard cutter now arriving on the scene.

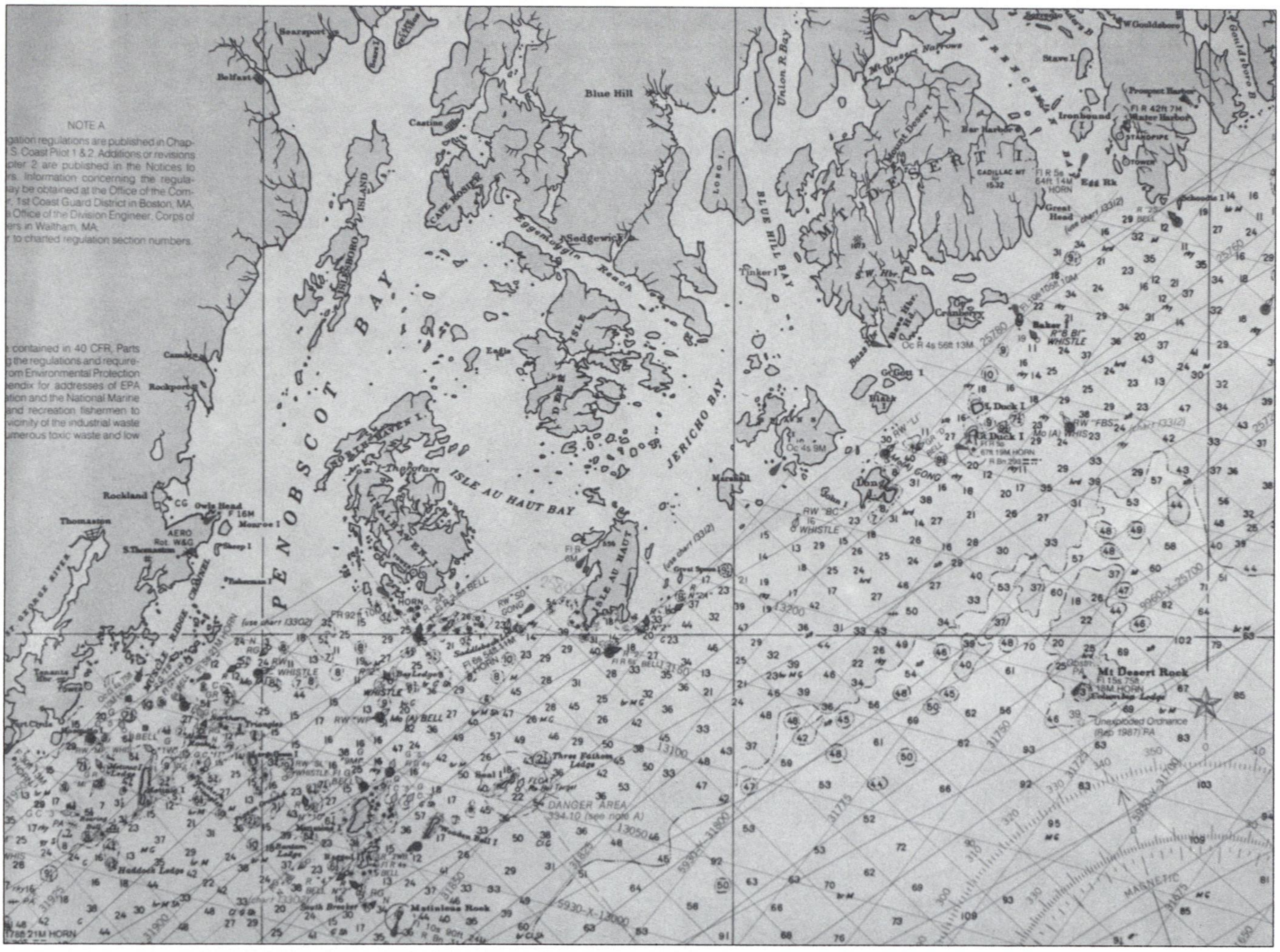
Bunker backed away and turned the ***Jan-Ellen*** in another direction, while the Coast Guard boat followed. Kohls and Murray resumed their sightless staring into sea smoke.

In the water Musetti fell into a dreamlike state as his body began the slow shutdown of hypothermia. He thought about his four daughters and three grandchildren. He thought about Cleves and Stevens and what this would mean to their families. Suddenly a light appeared in the distance, and he jerked himself into wakefulness. But as quickly as it had appeared, the light was gone. Musetti thought he was hallucinating.

Moments later he saw a second light coming toward them– this time from the opposite direction. He had always heard that freezing to death was a painless and peaceful way to go. *It's true*, he thought. *There really are angels! And they actually do come to get you.*

To his amazement, the angels began to shout at him. Suddenly there were boats around him and the others, and arms were reaching toward them. Slowly he understood. *We've been found*!

It took all the strength of the ***Jan-Ellen***'s crew



to haul the waterlogged bodies of Musetti and Cleaves into the boat while the Coat Guard retrieved Stevens. Kohls and Murray pulled their two passengers below and they struggled to get the frozen clothes off the two violently shaking men while Bunker turned the boat homeward.

When the ***Jan-Ellen*** and the Coast Guard cutter pulled into Matinicus, cars and trucks were waiting with thermoses, blankets and extra clothing. The crew of the ***Harkness*** was immediately wrapped in the blankets and driven to the warmth of the Bunkers' house. Death from hypothermia could still occur.

Sue Kohls and Sari Bunker did their best to make the three comfortable. They poured coffee, but the men's hands shook so violently that it spilled. When their shaking subsided, the men from the ***Harkness*** devoured reheated lasagna.

Much later, after they could talk, Musetti spoke up. "How did you find us?"

"The light," Kohls answered.

"What light?" Musetti asked.

"There was a flashlight frozen to Duane's glove," Kohls said. He retrieved it from the crew's wet belongings and banged it until it flickered to life.

Steven's jaw dropped. "That's mine," he said. His 16-year-old daughter, Robyn, had given it to him for Christmas, and he'd assumed that it had gone down with the boat. Cleaves explained that he'd grabbed it when he left the wheelhouse.

There was a stunned silence.

"What are the chances," Musetti finally asked, "that a turned on flashlight would freeze itself to the glove of a man whose hands were too cold to hold it.

"Or that a ladder would free itself as we went down–and float right over to me?" asked Cleaves.

Arthur Stevens spoke last. "And why did Robyn choose a flashlight, of all things, as a Christmas present for me?"

Rudy Musetti shivered, but this time it wasn't from the cold. "Thank you, Captain," he said to Vance Bunker. *And thank you, too,* he mused in silent prayer, letting his thoughts lift upward.

ABOARD THE IKE

LEE S. CHESNEAU
NATIONAL WEATHER SERVICE

The winds and waves are always on the side of the ablest navigators.

—Edward Gibbon

Ship captains and aircraft pilots are charged with awesome responsibilities in an often hostile environment. Lives and multimillion dollar equipment are at stake. When the weather deteriorates or a forecast is busted, the airplane pilot can often outrun or outmaneuver a storm. For the more vulnerable master of a supertanker or container vessel, there may be no place to run, no place to hide.

This crucial dependence upon weather makes it important for the marine forecaster to understand the problems facing a ship captain and for the ship captain to realize the limits of forecasting.

This interaction was forcefully driven home in March of 1993 during the "Storm of the Century" in the western North Atlantic. It was estimated that some 45 mariners lost their lives. Most heeded the accurate forecasts, some were forced by port closings to tough it out at sea, while others evidently disregarded the warnings. The casualty toll was significantly increased by the loss of the gypsum carrier ***Gold Bond Conveyor*** and its entire 33-member crew on the 14th.

Captain William Mullen, Master of the mv ***President Eisenhower****, has over 25 years of sailing experience, including 7 years with the mv* ***President Eisenhower****, which makes runs from California to Guam, the Far East and Japan, then the return trip back to California. Captain Mullen is a typical graduate of American President Line's outstanding training program for its Masters and Mates. The program teaches the intricate balance between theory and practical application of meteorology and oceanography.*

The mv ***President Eisenhower*** *is a J9 class diesel powered container vessel capable of carrying 5 high rows of containers and transit speeds of over 22.5 knots. The ship maintains a crew of 21 people as part of a 22-ship APL fleet of ships engaging in international trade.*

There was considerable speculation as to why the captain chose to sail that day even though at least three other ships elected to remain in Halifax Harbor after hearing urgent notice to mariners and severe weather warnings broadcast over the radio.

As illustrated by this devastating storm, mariners require timely and accurate graphic weather products (500 mb, surface pressure and sea state analyses and forecasts, etc.) both in the near term (24-72 hours) and extended range (96-240 hours) in order to make prudent decisions. Forecasters, in turn, need quality and timely weather observations from the ships at sea through the Voluntary Observing Ship program to be able to provide accurate and timely forecasts.

Communication between forecasters and mariners is being achieved through programs such as the Marine Institute of Technology and Graduate Studies (MITAGS) and through familiarization voyages aboard commercial vessels by the marine forecasters.

The tremendous strides in ship routing in the past several decades has brought a perception that skippers need only a rudimentary knowledge of weather and oceanography in order to follow their ship routing guidance.

To gain an appreciation of just how weather dominates every facet of ship operations, I had the privilege of making a transpacific crossing on the mv ***President Eisenhower*** in early March of 1993. This voyage provided a firsthand look at how HF radiofacsimile and Inmarsat satellite meteorological and oceanographic products are used. I also saw how mariners use the National Weather Service products for crew safety, damage avoidance and fuel conservation decisions.

During the past several years forecasters from the Meteorological Operations Division (MOD) have maintained close contact with professional mariners attending Maritime Institute of Technology and Graduate Studies (MITAGS). The Institute, in Linthicum Heights, Maryland, provides continuing education courses and refresher training to the professional mariner to help maintain or enhance their sea skills. The Heavy Weather Avoidance course provides an overview of practical meteorological and oceanographic principles as they apply to safe seakeeping. It familiarizes mariners with ocean wave theory, boundary effects, wind wave generation, violent ship motion, heavy weather maneuvers, rapidly intensifying storms and weather routing. It emphasizes the use and interpretation of NWS radio facsimile broadcast products. Mariners learn to interpret and use HF broadcast products which are prepared and disseminated by the Marine Forecast Branch of the MOD at the National Meteorological Center (NMC), Camp Springs, Maryland.

MITAGS also uses private sector services, such as those provided by Ocean Systems, Inc. OSI, through their Integrated Marine Decision Support System (IMDSS), provides a variety of interactive software programs. These programs are designed to predict individual ship motion, speed, power and fuel consumption in a given sea state. They include meteorological and oceanographic color graphics and text,

Lee Chesneau is a Marine Meteorologist with over 20 years operational experience in government and private industry as a marine forecaster and ship router. His most recent tour of duty included Operations Desert Shield and Storm, routing and forecasting for over 1000 multinational ships. He is currently involved with the upgrade of the National Weather Services's High Frequency Radio Facsimile Broadcast program at the National Meteorological Center in Washington D.C., which will continue in phases through 1994.

The mention of Ocean Systems Inc. is not an endorsement by the National Weather Service of one ship routing firm over another.

computerized tailored ship routing systems and communications via ship to shore file transfer, packaged for PCs equipped with Inmarsat A satellite reception capability. Weather data can be downloaded daily (from satcom A) providing sea state, 500 millibar and surface forecasts out to +168 hours.

However, the database for the displayed products is nearly 24 hours old upon reception. Radio facsimile data is more current (less than 12 hours) and this timely broadcast of the current HF suite of radio facsimile products complements private sector input for safe transoceanic crossings. The mv ***President Eisenhower*** utilizes both OSI and HF radio facsimile products.

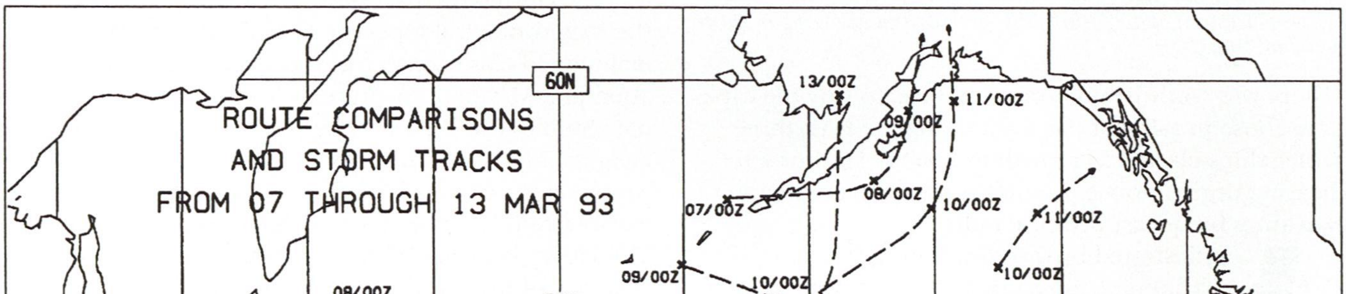
Initial route planning (based on medium range weather forecasting 96–240 hours) often begins several days before actual departure. Captains study daily the latest available upper air (500 mb), surface pressure patterns, significant wave forecasts, and ocean current data, such as the Kuroshio Current. Once at sea, decisions on underway track and speed adjustments (based on surface analyses and short range weather forecasts 24–72 hours) are made every day. Also considered are such local weather factors as barometer readings and wind direction and force, which provide the best verification of analyses and forecasts.

The primary mission of any ship making transoceanic passages is to meet departure and arrival deadlines with a minimum of cargo and ship damage. Competition between companies is fierce! Today's professional mariners not only are expected to be experts at seamanship, but also knowledgeable in meteorology. Whether using a ship routing service or doing their own ship routing, mariners who are not competent in marine weather fundamentals are at a distinct disadvantage as are their companies.

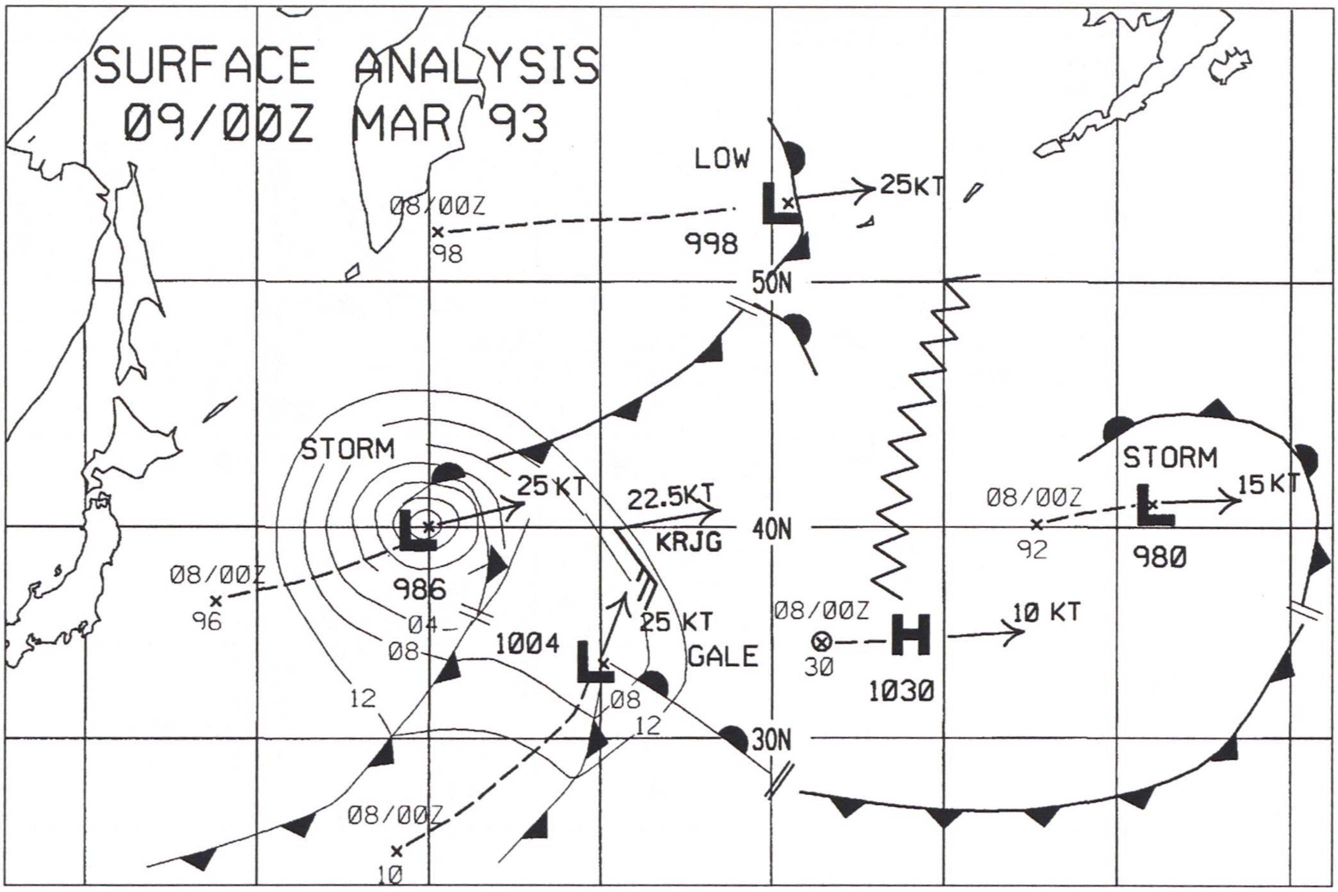
American President Lines, LTD and Sealand, for example, have taken the lead in ensuring its officers and crew are trained in all facets from ship handling, deck seamanship, engineering to practical weather and oceanographic forecasting. During my voyage, I learned firsthand how the value of years of hands-on experience combined with the academic classroom knowledge complement each other.

WEATHER DIARY

MARCH 06 – The mv ***President Eisenhower***, an American President Lines (APL) J-9 class diesel powered container vessel, with Captain William Mullen at the helm, departed Yokohama, Japan on the late after-



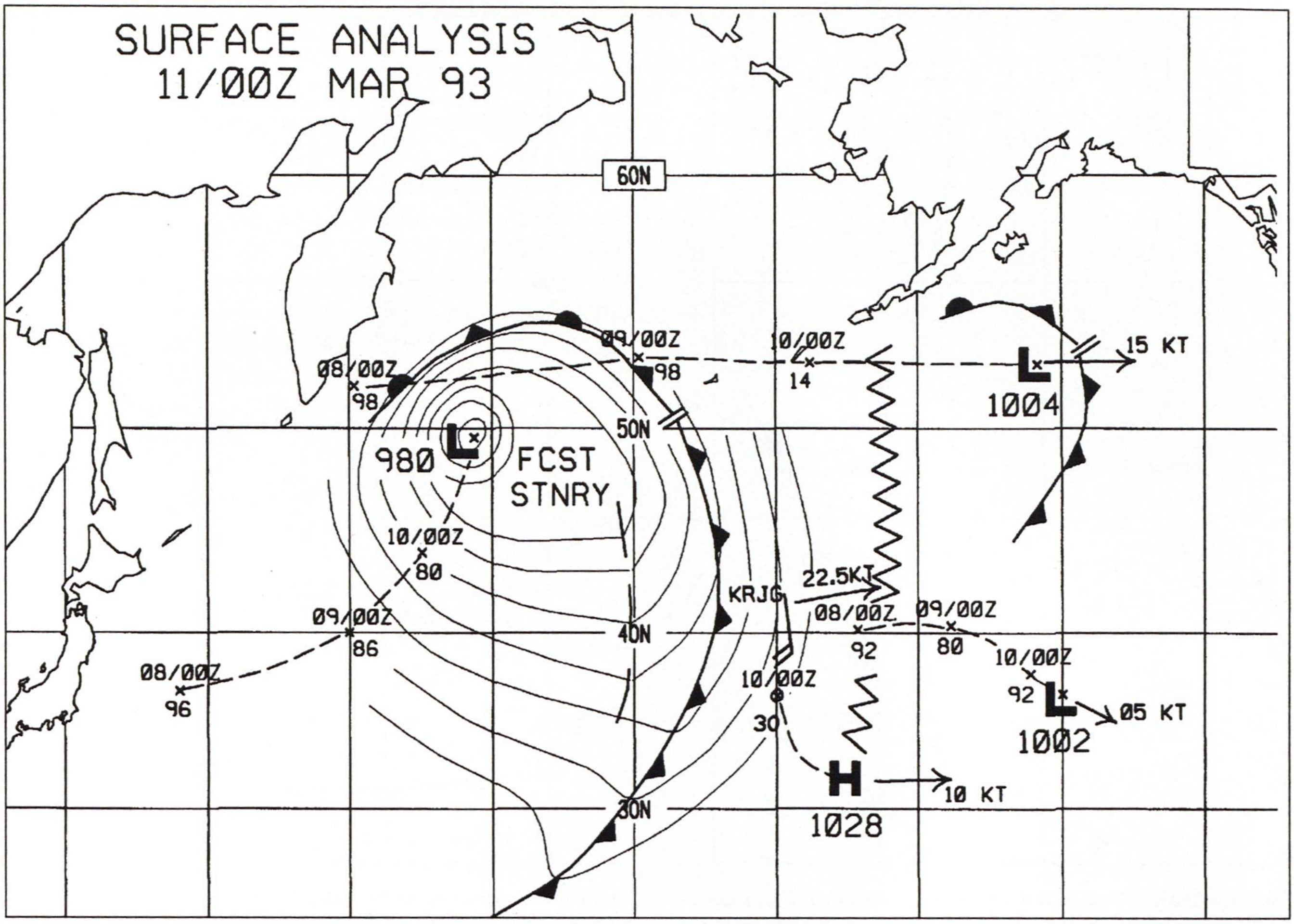
Above three route comparisons from Yokohama, Japan to San Pedro, California are overlaid with the storm track derived from OSI's 168 Hour Forecast, from March 7–13 1993. Also overlaid is the Kuroshio Current (Japan's Gulf Stream). Route #1 is a true Great Circle track, Route #2 is the OSI recommended route, and Route #3 is the composite route chosen by Captain William Mullen, Master of the mv ***President Eisenhower****. The difference in mileage between a true Great Circle (Route #1) and OSI's route (Route #2) is 20 miles, while the* ***President Eisenhower****'s route (Route #3) is only 70 miles longer than the OSI recommended route, yet a significant 300 miles to the south. Thus, IKE's route stays substantially below the storm track, giving the Master more options for enroute course/speed adjustments. IKE's route also takes advantage of the 3–4 knot Kuroshio Current, while avoiding a 1-knot counter current north of the Kuroshio Current, on Routes #1 and #2.*



Surface Analysis from March 09, 1993 at 0000 UTC. An unforecast secondary gale force Low to the southeast of IKE caused the winds to back and increase from southerly force 6 to south southeasterly force 8. The IKE (40°N, 172°W) broke off its parallel sail along 40°N to commence GC heading (076 degrees) to ease stress on the rudder trying to maintain a 090 degree heading (using as little as 5 degrees of rudder to hold course can reduce SOG up to 0.5 knots).

noon of March 6, 1993. The vessel was loaded with containers 4 decks high fore and aft. The ships displacement was over 44,000 metric tons with a draft of 9.4 meters, a trim of 0.6 meters, and a GM of 1.05 meters. The calculated roll period for given draft/trim/GM was 22 seconds. In addition to the weather charts, OSI also provided the master with the latest position, current velocities and temperature profiles on the Kuroshio Current (Japan's Gulf Stream), as well as a computerized route recommendation once specific ship parameters of the mv ***President Eisenhower*** were integrated. The OSI weather was then compared to the most recent HF radio facsimile broadcast of the surface analyses from JMH. MV ***President Eisenhower***'s initial track was to proceed from Nojima Saki, at 22.5 knots speed of advance (SOA) run up on a composite track to San Pedro, California, via RL (rhumb line) 37.5°N, 150°E (parallels approximate position of the Kuroshio Current), GC (great circle) 40°N, 170°E, parallel sail to 40°N, 160°W, GC Point Conception, direct San Pedro via the Santa Barbara Channel. The master chose the composite route to provide diversion options in the event the weather changed. Also the difference in distance between OSI's recommended route (close to a true Great Circle) and the composite route was only 70 nautical miles, which would be easily made up with an assist from the Kuroshio Current. In addition, Captain Mullen's experience and his knowledge of a counter current just north of the Kuroshio, entered into his decision. Remaining 300 nautical miles south of OSI'S route (along 40°N) would avoid the anticipated adverse head or bow winds and seas. On the composite route, the charts indicated a blocking ridge of high pressure in the central Pacific Ocean which would deflect storms to the north and west of the mv ***President Eisenhower***. Once clearing the current assist, a storm system forecast to track northeastward from Honshu meant winds and seas should remain abaft the beam (quartering) for the next several days.

MARCH 07 –0000 position 36°09'N, 146°35'E– We experienced an excellent boost of greater than 2 knots from the Kuroshio Current. Speed over

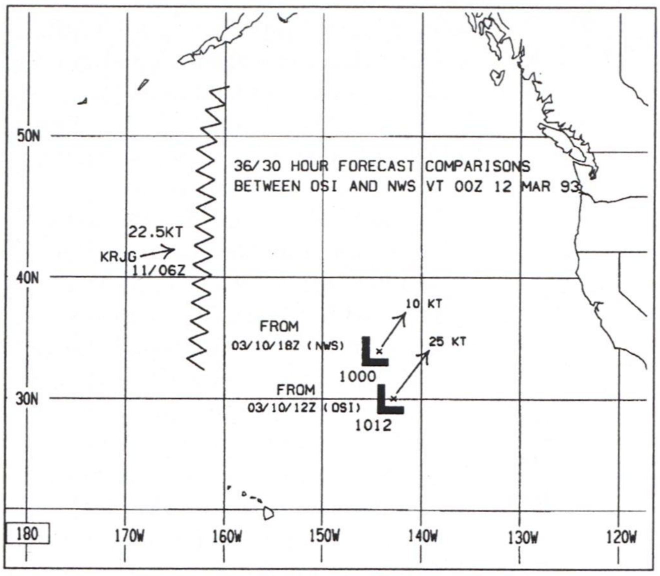


Surface Analysis from March 11, 1993 at 0000 UTC. The secondary gale force Low becomes absorbed by the primary storm system well to the northwest of IKE. Winds and seas moderate and veer to a more beam aspect as IKE (42°N, 169°W) maintains its declared SOA of 22.5 knot on a GC track. IKE is now heading into a high amplitude Ridge in the mid Pacific, enabling the ship to slow down and effect repairs of an engineering casualty to its main engine.

ground (SOG) averaged 24.79 knots compared with 22.5 knots run up on the engine order telegraph. The ship began to experience force 6 southwesterlies (abaft the beam) with rough quartering seas as weak low pressure systems passed just to the north of the vessel's track. The goal was to continue to maintain winds and seas abaft the beam as we left the Kuroshio Current. The developing storm was now forecast to move to the south of Honshu late on the 7th then east northeastward maintaining a position to the northwest of ship's track on the 8th and 9th. The radio operator picked up a number of ship weather observations off the Kamchatka Peninsula.

MARCH 08 –0000 position 38°32'N, 157°16'E– The rapidly developing storm moved off Honshu early on the 8th as forecasted. The latest OSI download indicated the Honshu storm system would accelerate northeastward toward the western Aleutian chain. The main concentration of energy was expected to remain north and west of the ship's track. The ship made excellent speed over ground (SOG) during the past 24 hours averaging 23.72 knots (a little over a 1 knot advantage), a combination of favorable Kuroshio Current and quartering swell resulted in a 22.50 knots SOA run up. Force 5 southerlies and moderate seas were expected to pick up overnight.

MARCH 09 –0000 position 40°00'N, 169°00'E– The latest 09/0000 surface analysis from JMH radio facsimile indicated a significant difference in the intensity and movement of the weather systems which would affect the ship. A secondary low, which was not forecast, formed southeast of the primary storm and to the south of the ship. It began generating force 6 southeasterlies, putting winds and seas forward of the beam. This is unfavorable to maintaining a good SOG since additional rudder would have to be used to maintain an easterly heading along 40°N (average SOG over the past 24 hours had been 22.97 knots).



Above is a 36/30 hour surface forecast comparison. Due to differences in forecast solutions between the OSI 36 hour and the NWS 30 hour forecasts in position, movement and intensity of a developing gale force Low 1200 miles to the southeast of IKE, the Master decided to wait 24 hours for better forecast resolution. The vessel near 42°N, 169°W was tracking through the mid Pacific Ridge after stopping 6 hours to repair oil leak to #6 cylinder of the ship's Seltzer engine.

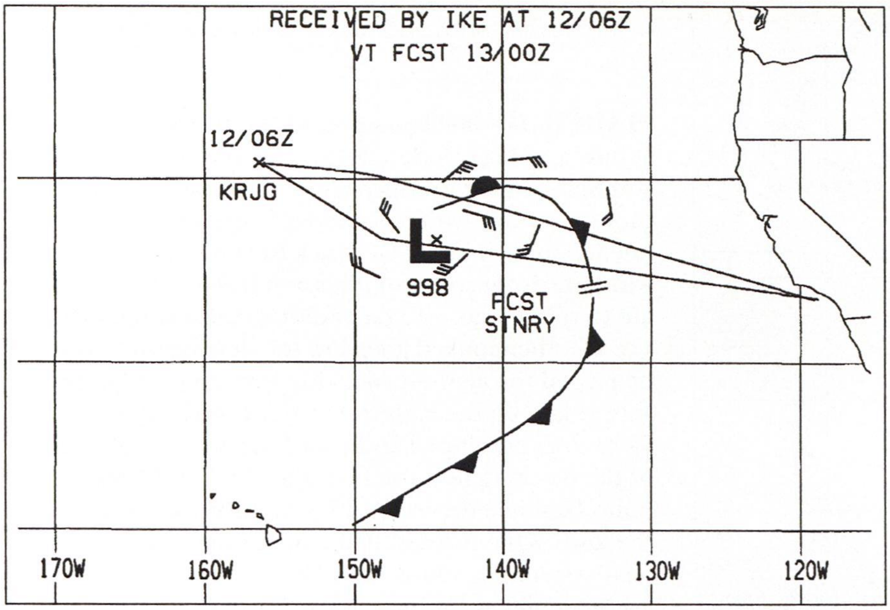
However, since the forecast from OSI did not address this secondary system, it appeared that the backing winds and seas would be temporary and would switch back to southwest once the low dissipated.

MARCH 10 –0000 position 40°30'N, 179°43'E– The winds and seas increased significantly overnight to force 7/8 southeasterly with seas building in excess of 6 meters (20 feet) forward of the ship's beam. All cargo and containers, however, were in good shape. The secondary low to the south of the ship intensified to gale strength as a result of the mid Pacific high pressure ridge holding firm. The storm initially moved east northeastward into the ridge but then was deflected to the north, just south of the ship. The increased winds and seas forward of the beam caused the rudder to labor to make a 090° heading, so the master broke off the route and began a GC track to Point Conception. The effect of this track adjustment was to ease the stress on the ship's rudder, and to maintain as close to 22.50 knot SOG as possible (past 24 hours SOG 21.99 knots). However, due to earlier gains only 21.82 knots was needed to make the arrival time into San Pedro. The radio operator switched from monitoring HF radio facsimile from JMH to NMC. We still hoped that the secondary system would be absorbed by the western Pacific storm northwest of the ship's position and heading toward the western Aleutians, bringing the winds and seas to a more southerly direction.

MARCH 11 –0000 position 41°47'N, 168°12'W– Winds and seas moderated and veered to a more southerly direction which allowed the ship to ride more smoothly with less rudder angle and ship stress needed to maintain a GC track to San Pedro. The wind was from south southeast at force 5 with moderate to rough seas. With conditions improving, the Captain then looked ahead to the next decision once he passed through the blocking mid Pacific high pressure ridge. In the eastern Pacific, a series of gale force lows developed and cut off on the eastern flank of the blocking mid Pacific ridge. OSI and NMC radio facsimile depicted different forecast positions of the lows. One forecast had a developing 1010-millibar system near 30°N, 140°W and another indicated a 1000-millibar low near 34°N, 140°W by 0000 on the 12th moving northeastward at 10 knots. One choice was to maintain the present GC heading to San Pedro and wait 24 hours to determine if a better confidence level on the forecast track of the eastern Pacific gale system was in the offing. The second choice was to start a RL heading to San Pedro, anticipating a northeastward storm track, which would bring winds and seas abaft the beam sooner as the ship moved under the low in winds and seas backing from northeast to northwest to west southwest. Since the ship was some 1200 miles from the low, the master postponed his decision. The ship was also some 15 hours ahead of scheduled ETA on the present track and SOG of 21.59 knots (21.86 knots was required for a March 14 evening versus March 15 morning arrival time). The captain would have preferred an earlier ETA to rest his crew overnight.

MARCH 12 –0000 position 41°54'N, 158°24'W– The radio officer switched to a HF PC based radio facsimile receiver when the main radio facsimile receiver failed.

Weather conditions moderated to near calm in the ridge axis with just a small northeast swell from the 1004-millibar storm system southeast of the vessel. The ship began a RL direct for Point Conception in anticipation of a slow northeastward movement of the storm. OSI calculated 6 hours of adverse winds and seas forward of the beam. The master considered diverting the ship on a more southeasterly heading. However, consideration of increased fuel costs due to added mileage was the main factor against this course of action. Captain Mullen took advantage of the good weather to stop engines and repair an oil leak in anticipation of worsening conditions ahead. The average SOG dropped off to 21.50 knots. However, only



This depiction of the wind forecast is from NWS's 30 Hour Surface Forecast from March 11 at 1800 UTC to March 13 at 0000 UTC. The HF Radiofacsimile forecast product was received on the ship at 0600 UTC on the 12th. The Master was faced with two decisions: divert under the gale force Low to minimize the duration of encounter of slowing winds and seas forward of the ship's beam and thus place conditions astern faster, or maintain present GC track to San Pedro and accept the slowing head conditions for 12–18 hours. The IKE was well ahead of schedule, due mainly to earlier gains from the Kuroshio Current assist. The Master decided to continue on the present GC heading since a diversion under the gale force storm would add too many miles to the voyage and increase fuel costs in a noncritical situation.

21.96 knots SOG is needed for an early morning March 15 arrival into San Pedro. The ship continued ahead of schedule.

MARCH 13 –0000 position 40°00'N, 147°18'W– Conditions worsened, as expected, with strong force 8 northeasterlies and rough to very rough building seas off the port bow. The ship proceeded on a RL track for Point Conception. The 1002-millibar gale force Low was some 450 nautical miles east southeast of the ship and accelerating northeastward. The winds and seas were now expected to back from northeast to northwest allowing for quartering conditions. The ship's SOG slowed to 20.18 knots. The master considered slowing the ship further to minimize the effects of pitching should it occur (this did not happen). With the 6 hours Dead in the Water from the previous day, the average SOG dropped to 18.52 knots while 21.94 knots were needed for early evening arrival into San Pedro on March 15.

MARCH 14 –0000 position 37°48'N, 137°42'W– As the east coast of the U.S. experienced the "Storm of the Century," the IKE passed through the broad center of the eastern Pacific gale force Low, as force 4/5 winds and seas backed to the southwest. The ship's barometer showed a steady fall to 1000 millibars the previous night then leveled off for 4 hours before beginning a slow rise. During the past 24 hours, the winds increased from force 8 northeasterlies off the port bow, to force 5/6 southwesterlies off the starboard beam, with marginally rough seas experienced. The low rapidly moved to the northeast and weakened, with no significant weather encountered on the remainder to the RL track into San Pedro. The average SOG over the past 24 hours was 21.43 knots. The mv ***President Eisenhower*** arrived on time in the early afternoon on March 15 as the bright late winter sun gleamed off the smooth waters of the Santa Barbara Channel.

A SUCCESSFUL TRIP

This trip was part of an effort to help the Marine Forecast Branch of the National Weather Service become more responsive to the professional merchant mariner. During the voyage, I saw the importance of preparation, neatness and accuracy in the present suite of radio facsimile graphic and text forecasts. I was impressed with the depth and knowledge of the *streetwise* mariner in meteorology and oceanography, especially its application to vessel performance.

As another part of the Marine Forecast Branch effort, mariners can look forward to an improved and expanded marine forecast program in the coming months as can other high seas users of NWS radio facsimile products generated from Washington, DC (see Radio Tips this issue).

I would like to express my thanks and appreciation to American President Lines, LTD, Captains Sandy Jones, Grant Stewart, and especially Captain William Mullen. In addition, thanks to Mr. Glen Paine, an outstanding instructor at MITAGS, for opening the door to a closer cooperation between the National Weather Service and the professional mariner. I would also like to acknowledge Mr. Ralph Jones on NMC's Automation Division for providing the graphics.

CoastWatch Regional Sites:

SOUTHEAST - NMFS, Beaufort Laboratory
101 Pivers Island Road, Beaufort, NC 28516
Contact: Alex Chester
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Omnet: NOAA.CWATCH.NC

NORTHEAST - NMFS,
28 Tarzwell Drive, Narragansett, RI 02882-1199
Contact: Reed Armstrong
COM (401) 782-3200 FAX (401) 782-3201
Omnet: NOAA.CWATCH.RI

GREAT LAKES - OAR, Great Lakes Environmental Research Laboratory
2205 Commonwealth Blvd., Ann Arbor, MI 48105
Contact: George Leshkevich
COM (313) 741-2265 FAX (313) 741-2055
Omnet: NOAA.CWATCH.MI
Internet: leshkevich@sparc.glerl.noaa.gov

GULF OF MEXICO - NMFS, Stennis SFC
Building 1103, Room 218, Bay St. Louis, MS 39529
Contact: Tom Leming
COM (601) 688-1214 FAX (601) 688-1151
Omnet: NOAA.CWATCH.MS
Internet: tom@bluefin.ssc.nmfs.gov

WEST COAST - NMFS/SWFC
P.O. Box 271, La Jolla, CA 92038
Contact: Mike Laurs
COM (619) 546-7086 FAX (619) 546-5614
Omnet: NOAA.CWATCH.CA
Internet: mike@cwatchwc.ucsd.edu

CARIBBEAN - NWS/NHC
1320 S. Dixie Hwy., Rm. 620, Coral Gables, FL 33146
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Omnet: NOAA.CWATCH.FL

CENTRAL PACIFIC - NMFS, Honolulu Laboratory
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632 6th Avenue, Anchorage, AK 99501
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**NOAA CoastWatch Program Manager: Kent Hughes - NOAA/NESDIS
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Maine Maritime Academy

Nancy O'Donnell

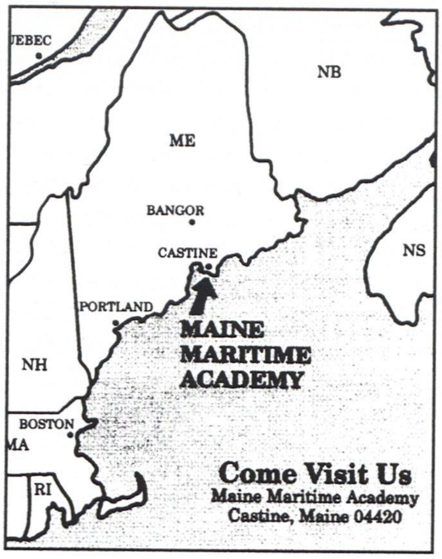
Whether man is disposed to yield to nature or to oppose her, he cannot do without a correct understanding of her language.
–Jean Rostand

The language of the sea changes over time, adapts to new inventions, and responds to the changing worlds it borders. In Rostand's quote, replace *nature* with *sea,* and the renewed mission of the Maine Maritime Academy (MMA) to not only adapt but flourish in these changing times becomes clearer.

Marine academies face new challenges: a shrinking Merchant Marine, technologies that reduce the human element in the decision-making essential to safe ocean travel, a changing marine environment threatened by industrial

Special thanks to John Staples, Director of Public Relations at Maine Maritime Academy and Dr. James Aldrich, author of *Fair Winds and Stormy Seas*, a history of the academy.

The design of Maine Maritime's new student center (left) reinforces its maritime heritage with elements reminiscent of a ship's structure. The building faces a commanding view of Castine Harbor.

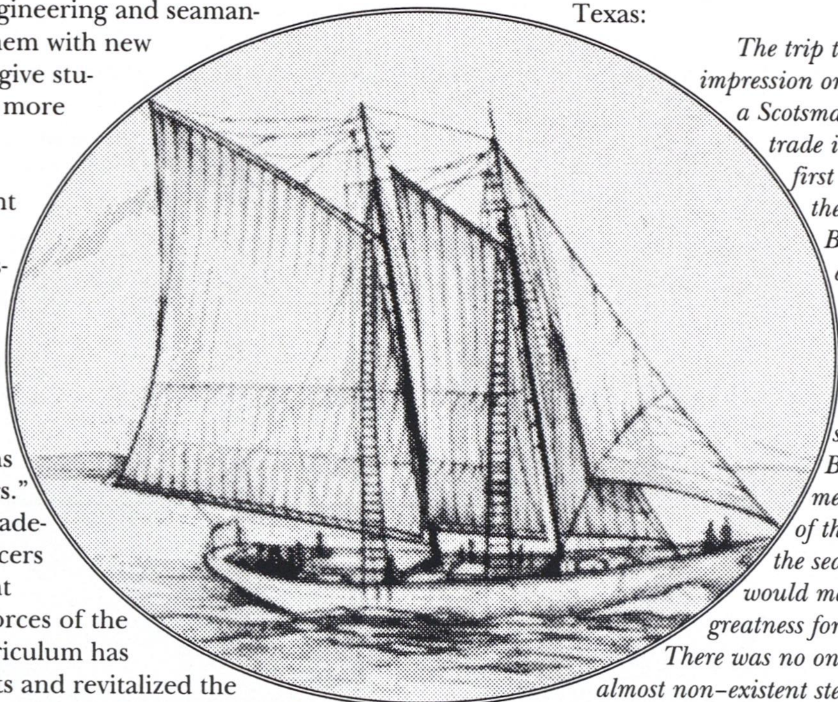


wastes on land and toxic chemicals spills at sea.

The academy's response to these problems is summarized in a recent essay by writer Lawrence Biemiller in the *Chronicle of Higher Education*: "The academy's plan for surviving in the 90s, in fact, trades on its strength in engineering and seamanship by overlaying them with new courses intended to give students a broader and more marketable range of skills– as oceanographers, as power-plant operators, as engineers who design systems for both naval and land-based needs, as managers in the merchant marine industry, even as yacht captains and marina managers."

While the academy still prepares officers for the U.S. Merchant Marine and armed forces of the U.S., the revised curriculum has increased enrollments and revitalized the campus– more women and civilians attend, while the faculty produce more diverse research. In 1992, the freshman class was the largest in the Academy's history—240 students admitted while 599 others competed-to get in. Yet much remains the same. Biemiller notes that 80% of the academy's undergraduates still seek the necessary licenses from the U.S. Coast Guard which allows them to join the regiment of uniformed midshipmen.

The history of the academy began with the colorful character of Ralph A. Leavitt, who in the early 1930s turned a dream of a state nautical school into an academy with an international reputation that today can boast of finding jobs for 95% of its graduates.



America was still catching its breath in 1936. The Depression had left more than 15 million people out of work when Leavitt sought members for a local branch of the Propeller Club, an organization that promoted the American Merchant Marine. He turned first to the Portland waterfront business community eager to promote the city's port.

Leavitt's motives were not just financial. Love of the sea was part of his genealogy. His great-grandfather had been a sea captain who boarded his first vessel at 15 years of age and succumbed at 28 to yellow fever in Havana. His grandfather was also a sea captain, as was his father.

In his memoirs, Leavitt details both his private passion for maritime life and his desire to build an American presence on the ocean. As a young man he shipped out on a 18-day voyage on a sulphur ship, the ***Herman Frasch***, sailing from New York to Sabine, Texas:

The trip to Texas made a great impression on me. The captain was a Scotsman who had learned his trade in British ships. The first mate was a Russian, the second mate another British-trained officer, and the third mate was a Norwegian.

As I stood on the bridge during watches, when a British ship went by, the Britons would explain to me that there went a ship of the greatest nation on the sea, and the Norwegian would make the same claim to greatness for ships of his country. There was no one to boast about the almost non-existent steel ship American Merchant Marine. The only Americans aboard the ***Herman Frasch*** *were the engineers, so I gravitated to the engine room a great deal of time.*

While the Propeller Club at first focused on local issues, club members soon voted to begin a larger project. For decades the young men of Maine interested in nautical careers were sent to training schools in Massachusetts and New York. One club member suggested that the Maine Legislature might be persuaded to provide its residents with tuition to the New

York school. Captain Clifford E. Metcalf, "Cappy Ricks" to his friends, heard of the club's efforts and decided he had a better idea–why not establish a merchant marine school in Maine? Metcalf and Leavitt decided to work together for a state academy.

In June 1940 Leavitt was elected to the state House of Representatives. His academy plans met with objections from all sides– critics pointed out that the Nautical School Act of 1872 stipulated that only eight states could have nautical schools and Maine wasn't on the list. Despite these objections, Leavitt introduced a bill for the "Maine Nautical School" which passed on March 21, 1941. MMA's biographer, James Aldrich, describes the enormity of Leavitt's undertaking, "In less than a year under the driving leadership of Ralph Leavitt, the Maine Maritime Academy had been authorized by the state, funded by both state and local government, organized and staffed, shore based in Castine, and provided with an opening class of students."

Rear Admiral Douglas Dismukes came out of retirement to become the school's first superintendent and the new academy moved into the 19th century Eastern State Normal School in Castine, Maine, some 150 miles north of Portland. By October 9, 1941, students began arriving at the small town on the edge of Penobscot Bay.

Castine claims a rich heritage. The French opened a trading post in 1513 and enjoyed amicable relations with the native Abenaki and Tarratine peoples, often marrying into the tribe. Later, the area would be named for Jean Vincent d'Abbadie de St. Castin who married Mathilde, daughter of Madockawando, a sagamore of the Tarratines. The area was first officially charted by Samuel de Champlain, geographer to France's King Henry IV in 1612, and a town was founded in 1613. However, the area was promptly recharted the next year by the British Captain John Smith as property of the crown. The two countries disagreed with each other on "ownership" for the next several decades until the British finally succeeded in driving the French out.

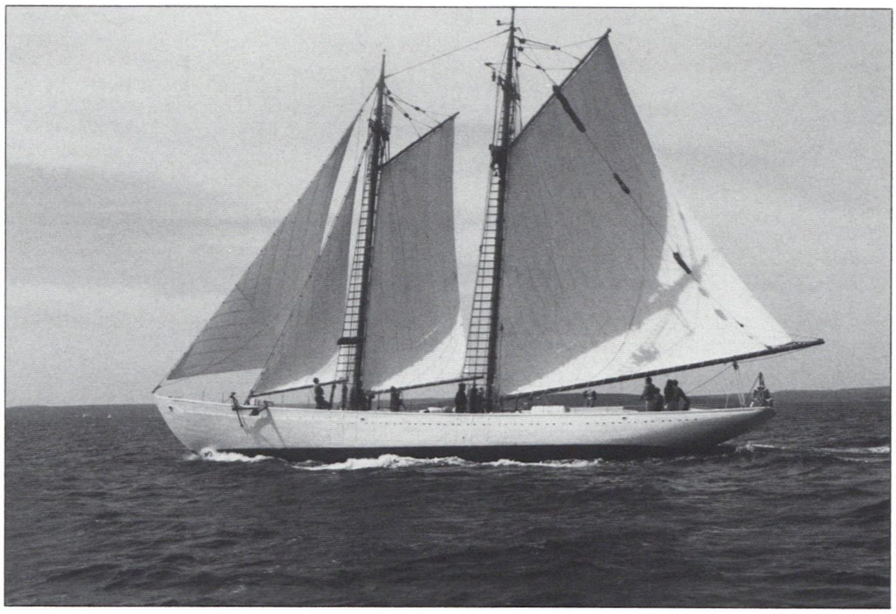
Penobscot Bay was the scene of what is considered one of the most disastrous of all American naval battles. The British General Francis McLean, in 1779, seized Majabagaduce, a military post in Castine. The Massachusetts Board of War responded quickly by sending 18 armed vessels and 24 transports with "1,000 ill-trained militia men and 400 marines" with Commodore Dudly Saltonstall of New Haven, Connecticut as commander.

When the armada arrived, the Americans couldn't find a suitable landing place for troops, and leaders couldn't agree on a plan of attack. Then Saltonstall refused to chase and fight three British sloops in the harbor. His fleet hesitated in the bay until August 14 when a superior British naval force

The 13,319-ton, 163-meter (533 foot) ***State of Maine*** *is the Academy's principal training vessel at least until it is replaced this spring. Each spring it sails on a 2-month cruise to domestic and foreign ports manned by freshmen and juniors. The vessel, formerly the S.S.* ***Ancon,*** *saw heavy combat duty during World War II as a communications and command ship in the invasion of Sicily, during the D-Day invasion of Normandy, and finally in the Pacific at Saipan and Okinawa.*

P. Eaton

The historic schooner ***Bowdoin*** *arrived in Castine in 1988. The Academy had leased the vessel for 2 years before purchasing it. The vessel has made 26 Arctic voyages in its 67-year career and its double wooden hull had withstood many challenges from Arctic ice. In the summer of 1990, the vessel returned to the Arctic on a 6-week training cruise with a novice crew of midshipmen after its exterior had been refitted. This was repeated in 1991 and another voyage is scheduled during July and August of 1994. Students will sail to Upernavik, Greenland some 786 kilometers (425 miles) north of the Arctic Circle. The* ***Bowdoin*** *is a National Historic Landmark and Maine's official sailing vessel.*



arrived and drove Saltonstall to retreat up the Penobscot River. Now trapped, Saltonstall scuttled his ships and subsequently was court-martialed and cashiered.

Castine's houses too have lively histories. The new Maritime Academy looked across the quad to Dressler St. and the J.A. Webster's "House of Sin." It received its name when neighbors learned its owner worked at the shipyards on Sundays. Farther down on Main Street was the J.A. Jarvis House whose owner was remembered for his marital ingenuity. When his wife died on a voyage from Liverpool, Mr. Jarvis quickly stored her in a barrel of rum so she'd keep until landfall and a proper Castine burial.

The first Maine Maritime Academy students had to room in the town's 19th century Pentagoet Inn because the dorms were not ready. The classrooms too were unfinished and some students built their own desks. On October 9, 1941, two months before Pearl Harbor, the academy officially opened with a class of 23 "mugs" as members of the newest class would be called and later that week the number increased to "the solid 28."

The demands of war shrunk the training calendar from 18 to 16 months and swelled the number of students so that at times they slept on canvas cots in the gymnasium and in the basement of the finished dorm. As one class completed sea training on Long Island Sound (they weren't allowed farther offshore because of prowling German submarines), they'd return to Castine and another class would take their place. MMA's first class graduated on May 29, 1944, and among them was Donald Ritchie, who would be killed in action at Iwo Jima. Two other graduates also died defending their country. In total, 300 officers served in the war. By 1946, when the curriculum returned to its original plan of 3 years, 66 students were enrolled.

The Academy continued to seek ways to improve and advance. It received its accreditation from the New England Association of Schools and Colleges in 1971. In 1972, Massachusetts Institute of Technology students joined with those at the academy for a Sea Grant Student Summer Laboratory project in Penobscot Bay. Their goal was to find the remains of two 18th century vessels which sank in the Bay during the naval confrontation in 1779. Professor Dean Mayhew of MMA collected the historical data and identified the brigantine ***Defense*** which still remains on the floor of the bay.

In 1978, no maritime academy shore facility was available to instruct students in the operation of supertankers. MMA responded by constructing a 9-meter (30 foot) scale model which floated in a "wet basin" in special facilities at the Academy.

Despite the innovations, the school struggled to identify its mission after the war and for the following decades students mirrored the changes in society from the most prosaic to the tragic. There were scandals that sometimes made the news: hazing, excessive infractions, militarism, and administrative incompetence.

What has been described as "course corrections" began under the administration of Kenneth M. Curtis, class of '52 in October 1986. Superintendent Curtis brought to the academy a renewed appetite for change.

The new superintendent quickly outlined the most pressing problems: "the old system that separated the student body into two groups, deck and engine...with a regiment of midshipmen too rigid and

Academy Profiles

Education at MMA has a very practical purpose– classroom academics must translate into real life ability. The students and teachers profiled here exemplify the academy's ethos– that the performance of tasks, whether commonplace or extraordinary, should be equally well done.

Associate Professor of Ocean Studies Dr Lauren Sahl, geologist/oceanographer, wants her students to become experts of Penobscot Bay,

"I want to set up a cruise program that will teach students how to collect data on Penobscot. We'll be the experts, since we're in the position of monitoring the Bay, and we can take the same kind of samples – temperature, salinity, density, nutrients, chlorophyll – and create a database.

Sahl, who received her BA. in Geology from the State University of New York at New Paltz and her doctorate in oceanography from Texas A & M, is excited about her part in the growing Ocean Studies program: "We're building a real good program. The academy is unique in that we can offer the experience on the water. In other schools the work fields are often quite a distance from the campus. Since our campus is right on the water, we're more of a hands-on school."

While the field of oceanography appears divided into two camps – oceanography in undergraduate studies vs oceanography in graduate school only – Sahl's response is a practical one. "The problem with starting in graduate school is that generally we lose a lot of people. If someone studies physics for 4 years, they're going to keep on with that." Sahl wants to make sure the smart ones don't get away. Come spring, Sahl will be cheering on the first three Ocean Studies graduates.

Cheering also will be her husband of little over a year, G. Anderson "Andy" Chase. Chase – who will admit is it only when asked – is a direct descendent on his grandmother's side of the renowned 18th century American navigator, Nathaniel Bowditch.

Chase himself is not unfamiliar with fame of a sorts. In 1990, the *New Yorker* magazine ran a series about the Merchant Marine by American travel writer John McPhee. McPhee's 3-part series was an account of a trip he took with Chase to the west coast of South America aboard the ss ***Stella Lykes***. After working on ships for 8 years, Chase returned to his alma mater but this time as an associate professor of nautical science. He easily lists the pluses of MMA and rattles off the names of academy boats like a list of old friends.

"We have great placement, but they won't all be 3rd mates on merchant marine vessels. There are a lot of boats out there and they need operators. The students here get focused training. Our students take two cruises on our own ship; other academics use more commercial ships," says Chase

"We have over 100 boats– an 80-foot tug, an 80-foot research vessel which does contract work, an 80-foot sailing schooner, a 40-foot oceanographic research ship, a 40-foot converted crew boat, and a slew of yachts students can take care of and paint."

One student graduate, Debbie Dempsey, '78, especially needed to remember her MMA training when she helped avert a significant environmental disaster off the Carolina Outer Banks. During a violent storm, the tow cables of a Lykes Brothers freighter ***Lyra*** snapped and it began drifting rapidly toward Cape Fear, North Carolina.

Within hours, Master Captain Debbie Dempsey, '78 was being lowered from a Marine helicopter onto the bucking deck. Within a few more hours, Dempsey, her chief mate Curtis Hall, two engineers–George Bradley (MMA) and Brian Norton– tried to get the ship's emergency generator going and when that failed, lowered the ship's massive anchor by hand. The freighter came to a halt 16 miles off shore. An account of this daring rescue appears in ***USA Today***, January 28, 1993.

Dempsey seldom balks at challenges. In 1974, she was the first woman admitted to a state marine academy, and in 1989 was the first female U.S. captain to sail an international freighter. In a recent article in the *Master Mate and Pilot*, the difficulties Dempsey faces as a female in a still predominately male field were apparent–when she sails into Egypt where women aren't allowed to captain big ships, Dempsey "puts on a hat and lowers her voice."

On Dec. 4, 1990, the academy awarded the prestigious Presidential Commendation to two midshipmen for heroic actions while on a cadet shipping assignment. Patrick Eustler and Peter Podest were aboard a Puerto Ri'can container ship about two hours from the Dominican Republic. With Podest standing watch, Eustler and a regular crewman discovered 11 stowaways in a large metal container supposedly full of cocoa beans. Fumes from a toxic substance used to treat the beans had already killed five persons and a sixth was near death. Eustler and Podest cut away the container top and administered" oxygen and joined in a rescue effort that saved five other stowaways.

During non-cruise periods, students in the 4 and 5 year USCG license majors are expected to satisfy the watch standing requirements of the Academy. Students are also required to participate in the Ship Laboratory Program to maintain the training vessel and to gain practical shipboard experience.

narrowly focused for the institution he envisioned, the decline in enrollment and the necessity for better job placement, reconstruction of the existing facilities, and most important, damaged morale." With the change in administration, the academy embarked on a campaign to upgrade and diversify its curriculum and its mission. By 1992, 47 women had graduated from Maine Maritime. This year's enrollment stands at 50.

MMA, considering itself a hands on school, has increased the number of training vessels to 100 including a barge, the 13-year-old tug ***Pentagoet,*** small sailboats and the majestic 167-meter (550 foot) long ***State of Maine.***

A new ***State of Maine,*** built in 1971, will arrive sometime in 1995 to replace the original and will allow students to work on diesel engines. Additionally, it will have a wide range of scientific instruments that will benefit students in ocean studies.

The historic 1921 schooner ***Bowdoin,*** a National Historic Landmark and Maine's Official Sailing vessel, was first leased for 2 years then purchased in 1989. Its double wooden hull has withstood 26 Arctic voyages and taken students to Labrador and Greenland under the command of Donald B. MacMillian. The ***Bowdoin*** logged over 3,000,000 miles in the Arctic while conducting scientific research.

The ***Argo Maine*** research ship is the only oceanographic platform based north of Cape Cod. A National Science Foundation (NSF) grant led to the acquisition of this 24-meter (80 foot) ship which operates in cooperation with the Association for Research on the Gulf of Maine. NSF support also led to a Conductivity-Temperature-Depth Probe co-owned with the University of Maine, and, along with private funding, has produced a Remotely Operated Vehicle and a Side Scan Sonar system.

The ***Friendship***, a 14-meter (47 foot) stern trawler now converted to a research vessel, came from a private donation. The vessel comes equipped with side-scan sonar and a remotely operated vehicle and serves primarily in the Ocean Studies Program.

MMA also owns a state-of-the-art ROV or remote operated vehicle that is used for underwater observations and contains black and white and color cameras and a robotic manipulator.

The Corning School of Ocean Studies program is one example of the academy's new vision. The program was started 3 years ago with a gift from a Maine resident, Nathan E. Corning. As a teenager, Corning sailed on the ***Bowdoin,*** and though he left Maine to work in investments in Boston, he returned each year to Castine for reunions. In 1990, Corning agreed to endow $550,000 to the school for an Ocean Studies program.

"The school is gearing up to become a center of undergraduate marine science," said the program's director John Barlow. "We also want to play a role in developing new industries which rely on the application of technology to the ocean." Students can now receive a B.S. in Ocean Studies concentrating on such courses as Marine Biology, Ecology, Physical Geology, Marine Geochemistry and Atmospheric Pollution Studies.

John Staples, Public Affairs director, praises a program that "graduates students who not only know how to run the vessels but are able to take samples"–students who see the importance of seamanship and research.

Student Regina McCarthy,'94 agrees. "On weekend cruises we may learn water and bottom sampling, and salinity testing, along with seamanship. You can study biology or chemistry in a lot of places,"

The Nautical Sciences department offers studies in various practical topics of vessel operation and navigation. The curriculum also includes course in management and other associated subjects as they relate to the maritime industry. Two majors, Marine Transportation and Nautical Science, lead to a Bachelor of Science degree and, if eligible, students may sit for a federal examination for the Third Mate's unlimited tonnage license.

McCarthy says, "but here you learn specifically how they relate to the marine environment."

Students required to cruise Penobscot Bay and the Gulf of Mexico as part of an upper level year project also collect baseline data for Penobscot Bay which is then made available to faculty and other students for their research projects. This pragmatism–combining academics with hands on experience–carries into all of the majors. Students train at sea 60 days in each of their 3 years at the academy. Freshmen and Juniors ship on the ***State of Maine*** while sophomores are assigned to commercial vessels worldwide. This cruise time enables them to make valuable contacts that often prove fruitful after graduation.

Most students have professional job offers before graduation because of the school's emphasis on early involvement in developing a career strategy. Freshmen attend weekly information sessions given by a wide range of companies representing potential jobs on land or sea. By sophomore year, many students are working directly with employers in the Cooperative Education program, cadet shipping and internship programs. The cooperative education program involves one spring and one fall semester in an off-campus organization such as Brookhaven Laboratories, General Dynamics and General Electric. Students accepted into this plan take 5 years to complete the entire program.

Many of the students are members of the Regiment of Midshipmen who work towards getting a license in the U.S. Merchant Marine. The academy offers six majors in addition to Ocean Studies: Marine Engineering Operations, Marine Engineering Technology, Marine Systems Engineering, Nautical Science, Marine Transportation, and Power Engineering Technology. Its offers minors in Management, Humanities and Social Sciences, Nuclear Power, Naval Architecture or Oceanography. Also available is a 2-year program in Yacht Operations and in Marina/Boatyard Management.

The Ocean Institute, originally named the Center for Advanced Maritime Students and established in 1980, is a continuing education and training program for professionals in the shipping industry.

MMA's Masters program was created in 1972 to meet particular requirements of sea-going officers and middle managers who wanted to broaden their skills and advance themselves in maritime-related companies.

Academy students have often moved beyond their campus to help others in the marine field. A group of MMA students donated hours of their time in the reconstruction of a historic vessel, the Lightship ***Nantucket,*** when they overhauled the top end of the vessel's 900-HP Cooper-Bessmer diesel engine. Built in 1936 to replace a vessel that

LCDR Craig McLean

*The Russian training vessel **Druzhba** is a full ship, square-rigged on all three masts. The 2257-ton vessel was built in 1987 in Gdansk, Poland. Maine Maritime and the Makarov Maritime College of St. Petersburg, Russia, are partners in exchange programs involving both students and faculty.*

was rammed and sunk by the sister liner to the ***Titanic***, the ***Nantucket*** was the largest and strongest floating lighthouse ever constructed in the United States. It pioneered several safety and navigational features before it was finally decommissioned in 1975.

Maine Maritime Academy has increased its international connections over the years. The ***State of Maine*** was the first U.S. training ship allowed in the Soviet Union when it sailed to Leningrad, now St. Petersburg, in 1974. From that first visit, the two colleges became partners in student and faculty exchanges. The Russians reciprocated and sent the ***Druzhba***, a beautiful full-rigged schooner, to Castine in 1990. MMA students were assigned Russian cadet activities and learned the Russian rigging names and commands, while the Russians learned the English names. MMA continues to strengthen a cooperative effort with the Russian Markarov Maritime College.

By 1993, 8% of the 683 MMA's students come from such countries as Brazil, China, Liberia and Panama. In addition, the academy enjoys a reciprocal program with the British Royal Navy. Spring of 1991 saw the signing of an agreement between MMA and Turkey which was aimed at building cooperative education programs between the school and Dokuz Eylul University in Ismir, Turkey. Earlier MMA had forged a partnership with Istanbul Technical University Maritime College. The academy also exports its teachers for on site seminars in Singapore, Lagos, Nigeria, and there are plans for a seminar in the Philippines.

Academy graduates have excelled in many fields. Robert Somerville, '65, is now president of American Bureau of Shipping. Gordon Ward '59, heads the National Marine Engineers Beneficial Association (MEBA) which represents 3000 banks. David Loeb, '43, is President of Countrywide Credit Industries, a large mortgage company. Edward Bulmer, '66, is President of Sprague Energy Co., a major supplier of oil products in New England. Dick MacPherson, former coach of the New England Patriots, attended Maine Maritime from 1948 to 1950 and received an honorary doctorate at Commencement 1992. The current president of MMA is Kenneth M. Curtis '52 former Governer of Maine from 1967-75 and U.S. Ambasador to Canada from 1979-81.

Curtis summarizes his Academy training: "My experience at Maine Maritime Academy instilled self-discipline, personal pride, and, most importantly, the often forgotten work ethic ... None of us can be sure where life will take us, but the lessons young people learn on this campus will always be invaluable."

Over the years, the academy's mission statement has reflected the world around it. It first promised training that would qualify men by giving them "an understanding of naval procedures to permit efficient service with the Navy in time of war." By 1969, the mission pledged to "to qualify [students] for leadership as officers and gentlemen in the U.S. Merchant Marine and in the U.S. Naval Reserve and as responsible citizens in society." Finally in 1991, the text had again been rewritten: "The mission of the college is to provide an educational environment which stimulates intellectual curiosity, fosters professional competency, encourages rigorous self-discipline, and develops leadership potential. ... Maine Maritime provides public service to the state, while perpetuating Maine's heritage of the sea." For 53 years the Maine Maritime Academy has worked to teach its students, from all the corners of the world, to learn the language of the sea with all its intonations.

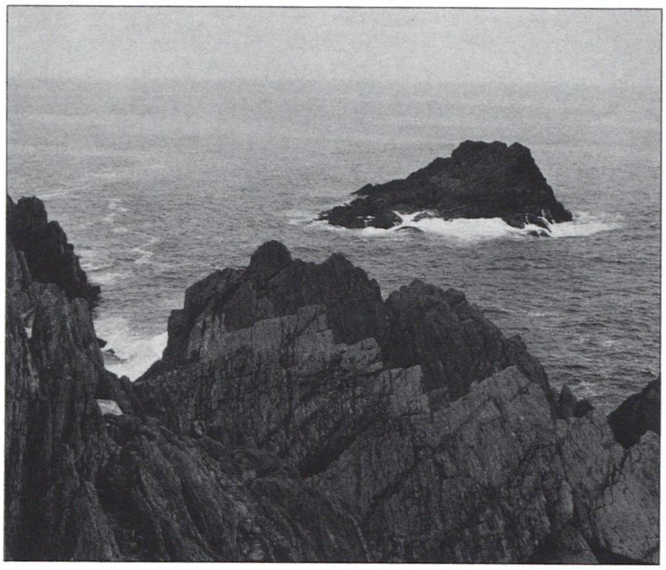
Cape Race: Sentinel to Disaster

Gerard Thorne
Photographs by Philip Dattilo

The first land often sighted by ocean-going ships on their way to the New World was the barren, jagged rocky cliffs of Newfoundland's Avalon Peninsula known as Cape Race. For many unfortunate vessels caught in its swirling fogs and currents, it was the last land sighted.

Its dangerous currents, icebergs and foggy coastlines have plagued shipping since the days of the Leif Eiriksson. In its heyday Cape Race was a key communications hub and a rescue center. But for all the maritime disasters, Cape Race will be forever linked with the world's most famous– the sinking of the ***Titanic*** in 1912.

In September of 1854 the ***Arctic***, pride of the Collins Line and, at the time, America's most magnificent ocean liner, went down off the cape after colliding in fog with the small French steamer, ***Vesta***. The passengers on the ***Vesta*** took to lifeboats and all survived, but the passengers and crew on the ***Arctic*** were not so lucky. More than 320 of the people on board were lost including the wife, son and daughter of the shipping line's owner, Edward Collins.



Philip Dattilo

The remains of the steamship ***George Washington*** were found at Bristow Cove in January 1877, just 7 miles from the cape. The wreck was discovered when local fishermen spotted several bodies floating in the surf. The ship had smashed to pieces, and no survivors were found.

The British warship H.M.S. ***Flamingo*** was passing the cape in 1881 when out of the fog loomed a giant iceberg. The berg was no sooner spotted then the ***Flamingo*** hit it. The unfortunate vessel sank within site of Cape Race although the crew managed to make it safely to shore. Unlike the ***Titanic*** disaster 30 years later, the visibility at the time of this collision was much reduced by the fog.

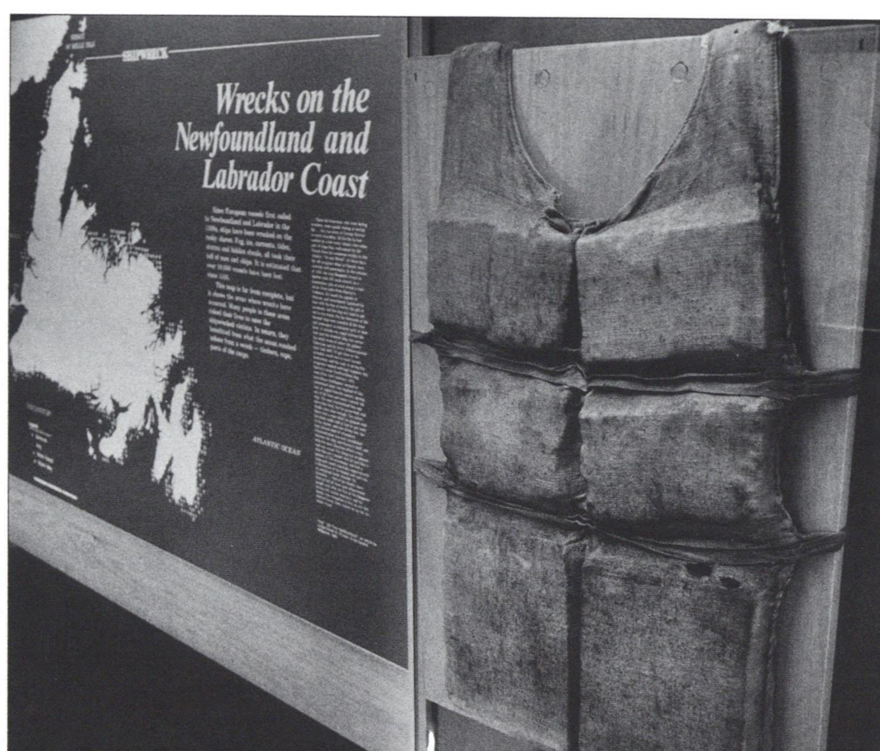
On the morning of February 23, 1918, the Red Cross steamer ***Florizel*** went aground in a winter storm 20 miles north of the cape. The 3,000-ton vessel was in service from New York to St. John's, and on this trip was carrying 147 passengers. At 6:00 a.m, wireless operators in St. John's picked up the following distress call from the ship: "We are ashore and in imminent danger of destruction." By the following afternoon, the ***Florizel*** was being pounded by heavy seas, and a few survivors managed to stay alive by crowding into the portion of the ship that was still above water. Local residents were able to rescue only 53 of the passengers and crew.

Cape Race Hazards

The area around Cape Race encompasses some of the world's most dangerous and foggy coastlines. When warm, moist Gulf Stream air passes over the cold water from the Labrador Current, it produces "pea soup" fogs which shroud the area about 158 days each year, July and August averaging 20 days each. For decades, the fog that billowed around Cape Race created a blanket of such thickness that on some days even the 13 lamps of Cape Race lighthouse could barely penetrate it, and it has been named as contributor to a number of sea tragedies that are now a part of Canadian maritime history.

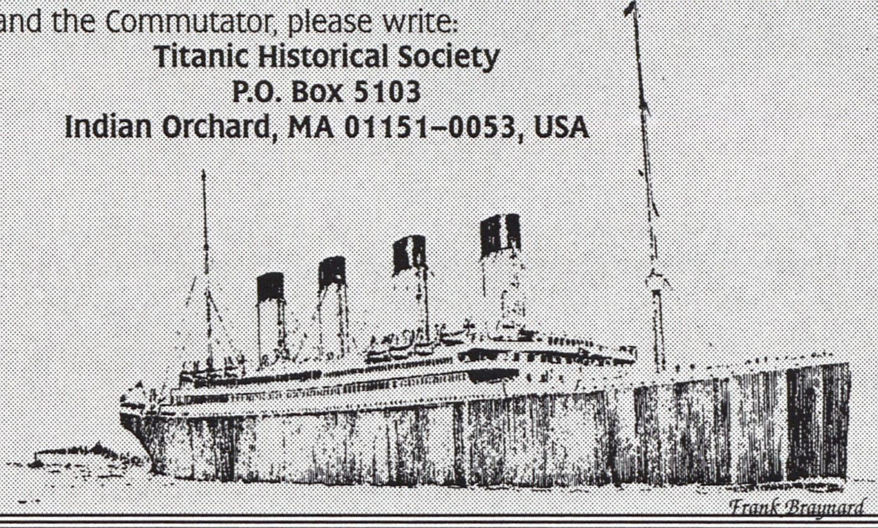
The currents passing Cape Race play a major role in transporting one of shipping's greatest threats—icebergs. Ice forms in great sheets which may stretch for hundreds of miles with great variations of thickness. Most dangerous are the icebergs that form in Greenland and drift down into Atlantic shipping lanes.

Because of its critical location, a wireless was



Philip Dattilo

The Cape Race Lighthouse stands at the very tip of Newfoundland's Avalon Peninsula (above, left). The original lighthouse was built in 1856, the year that the Wabash and Erie Canal opened after 24 years of construction. The rocky coast of Newfoundland (above) has claimed many ships over the years. A testament to this is on display at the Maritime Museum at St. John's (right) along with a Titanic lifejacket found washed up along the Cape Race coast in the summer of 1912.



established at the cape in 1904, a short time after Guglielmo Marconi received the first transatlantic message from Cornwall, England at nearby Signal Hill overlooking St. John's Harbor. Cape Race served as a communications point and was often instrumental in coordinating rescue efforts into the 1960s when its function was gradually displaced by technology. During World War I and World War II, submarine sightings were relayed from the cape so that the allies were able to organize and if necessary reroute Atlantic convoys. Prior to wireless communications, the Associated Press stationed a news boat at Cape Race to catch the mail steamers coming from Europe. The latest news was dropped overboard in a watertight canister, and any fisherman who presented the container to the postmaster was rewarded with £5 sterling. The news upon reaching the lighthouse was relayed to the rest of North America. By this method, news reached land several days before the ship. This procedure was maintained until the first transatlantic cables were laid between England and Newfoundland in 1866.

Does this lonely outpost simply stand as a monument to the past or does it still have a roll to play in modern shipping?

Cape Race Copes

The first weather problem to be dealt with was the fog. Because of Cape Race's close proximity to major Atlantic shipping lanes, particularly those leading to the St. Lawrence Seaway, the British government built a lighthouse on the site in 1856. The 40-foot iron tower was reinforced with a stone wall. The lighting system was of a fixed nature and had 13 lamps and associated reflectors. At 180 feet above sea level, it produced a beam visible 17 miles at sea on a clear night.

The lights at Cape Race, while a definite improvement, were found to be inadequate by themselves in dealing with the fog. On April 27, 1863, the Allan Line steamer ***Anglo Saxon,*** bound for Quebec City from Liverpool, fell victim to fog and rain off Cape Race when it struck the rocks of Clam Cove about 4 miles north of the lighthouse. The fog that night was so dense that the ship's lookout did not see the warning lights on the cape. Some of the passengers and crew escaped by climbing over the bow onto a rocky ledge. Less fortunate were those who launched lifeboats only to perish in the rough seas as well as those who remained on board the sinking vessel. In all, 237 lives were lost. Lighthouse keepers rescued those huddled on the ledge. Again and again, the men lowered themselves over the jagged cliff to carry the freezing, exhausted survivors to safety.

An investigation determined that a foghorn was needed, and in 1872, a steam whistle was installed. The whistle remained until 1901 when the British steamer ***Assyrian*** ran aground after mistaking the whistle for another ship. It was soon replaced with an air-operated diaphone horn.

Titanic Wireless

To all three wireless operators of Cape Race, Sunday, April 4, 1912 (all time given is ***Titanic*** time) started no differently than any other day. Chief wireless operator W.J. Grey spent most of the day in contact with transatlantic ships and local coastal steamers. Grey's assistants that day were Herbert Harvey and his 15-year-old apprentice, Jim Myrick. For the next 12 days, Jim was to be initiated into a world of modern wireless communications in a most memorable way. Until 9:30 P.M., Grey and his assistants were moderately busy relaying messages between ships and shore. Shortly after 9:30, Grey began to pick up the signal of the White Star Line's newest vessel, the 46,000-ton ***Titanic***. Grey learned that its chief wireless operator was John Phillips, a man with whom he had corresponded many times before. Phillips had a large number of personal messages to be relayed throughout North America. The messages were mostly from the first-class passengers who couldn't resist the urge to send tidbits of information to friends and relatives. The procedure at Cape Race was to record each message on a small green card. From there the messages would be relayed to their destinations.

The transfer of messages between Phillips and Grey continued for the next couple of hours. The transmitting became so routine that Grey decided to try to catch a few hours sleep. At approximately 11:55 P.M., the ***Titanic*** informed Cape Race that all messages had been sent and a period of wireless silence followed.

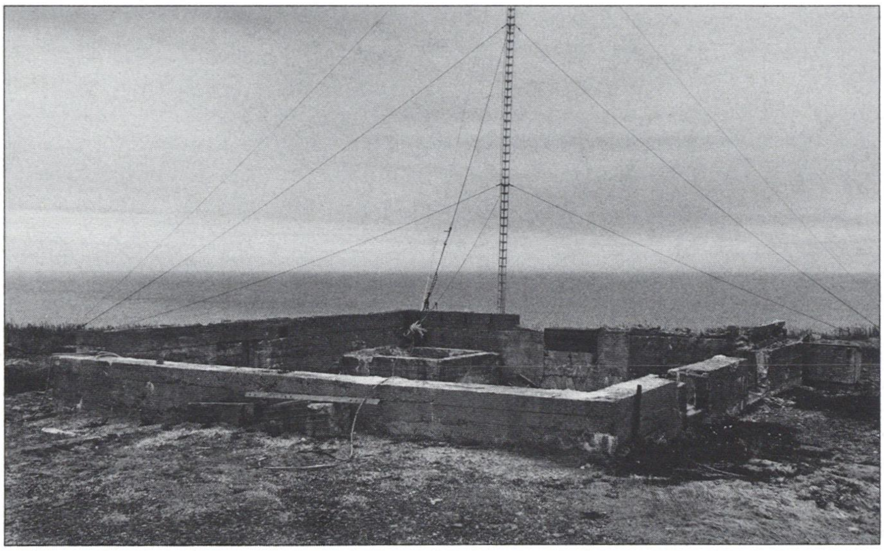
Message That Rocked the World

At 12:15 A.M., the silence was broken by the sound of the wireless receiver emitting the letters CQD...CQD...CQD...CQD...CQD...MGY 41° 44'N, 50° 24'W. The letters were repeated six times then followed by the letters MGY. Harvey recognized the call signal of the ***Titanic***. At first, he was skeptical. Why would the largest ship in the world be sending out a distress signal? Just minutes before its operator had been casually sending personal messages. Approximately 30 minutes later the ***Titanic*** replaced the international distress signal with the newer, simpler SOS and gave a new corrected position as 41° 46'N, 50° 14'W. Now assured that, indeed, the ***Titanic*** was in some sort of trouble, Harvey raced next door to Chief Officer Grey. Grey too was skeptical, but he returned to the wireless house.

For the next 2 hours, the operators at Cape Race received and relayed the news to other ships and land stations.

1:02 A.M.– Cape Race tells the ***Virginian****'s wireless operator to tell his captain that the* ***Titanic*** *has struck an iceberg and requires assistance. The* ***Virginian*** *attempts to reach the* ***Titanic*** *but gets no response.*

1:20 A.M.– Cape Race tells the ***Titanic*** *that the* ***Virginian*** *is*



Philip Dattilo

The remains of the Marconi Wireless Station (left) mark the very spot where the first distress call were heard from the ***Titanic****. During the 1960s the wireless station was removed, and most radio duties are now handled by stations in St. John's and throughout Atlantic Canada (New Brunswick, Nova Scotia/Cape Breton, Prince Edward Island and Newfoundland/ Labrador).*

During both World Wars, Cape Race relayed submarine sightings so the allies were able to organize and, if necessary, reroute Atlantic convoys. In 1944, an iceberg was once again responsible for the loss of a vessel but this time with a different twist. As H.M.C.S. ***Valleyfield*** *was passing the cape, it paid little attention to a large iceberg nearby. Without warning, a German U-boat suddenly appeared from behind the berg and sank the* ***Valleyfield****.*

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The nightmare of the Titanic's sinking is conveyed in this stained-glass rendering of a ship's foundering (left). The Greek inscription is taken from the words of Christ on the cross: "My God, my God, why hast thou forsaken me?" The window is located in St. Joseph's Catholic Church, Dingwall, Nova Scotia.

Tom Ryan, Head Lighthouse Keeper, stands within the giant fresnel itself (right). In November 1929 a large undersea earthquake rocked the Grand Banks region. The tremors set up tsunamis which were responsible for many deaths in small coastal Newfoundland towns. They also reached Cape Race and produced a large crack in the lighthouse tower. The split extended the full length of the tower and extensive repairs were necessary.

*going to its assistance. The **Virginian** is 170 miles north. 1:40-A.M. Cape Race to **Virginian**, "Please tell your captain this. The **Olympic** is making all speed for the **Titanic**, but its position is 40° 32'N, 61° 18'W. You're much nearer ... The **Titanic** is already putting women off in the boats, and he says the weather is calm and clear. The **Olympic** is the only ship we have heard say, 'Going to the assistance of the **Titanic**,' the others must be a long way from the **Titanic**." 1:55 A.M.- Cape Race to the **Virginian**, "We have not heard from the **Titanic** for about half an hour. His power must be gone.*

And on it went. For the next few hours, the operators at the cape tried to obtain information about the ***Titanic***'s condition. Any ship that was within range was contacted. At 7:25 A.M., the coastal steamer ***Bruce*** passed Cape Race on the way to St. John's. The ***Bruce*** was a compact, 1,500-ton vessel that ran between St. John's Port Aux Basque, a small community on the southwestern tip of Newfoundland, and Sydney, Nova Scotia.

As the ***Bruce*** was passing, it received the following message, *"**Titanic** lost last night in 41° 56'N, 50° 14'W. Is largest ship afloat and ran into iceberg. From the time it struck until last we heard of it was 1 hour 45 minutes. About 3,000 passengers on board. We were working with it until its signals went up."*

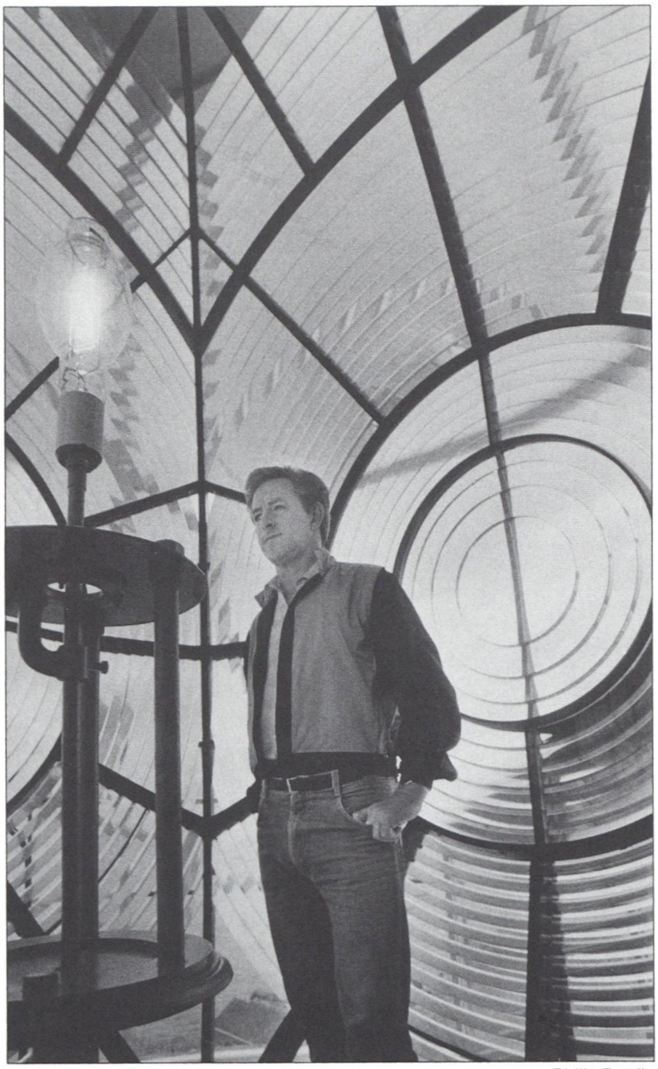
The ***Bruce***, as many operators that night, had shut down its wireless just as the iceberg struck and so had not picked up any of the ***Titanic***'s distress signals. Only the Cape Race wireless operators remained at their keys for over 96 hours with little time for rest or food.

The swiftness of the ***Titanic***'s sinking was yet more proof of the danger of icebergs in the area. The year 1912 was remembered by many mariners as one of the worst on record for icebergs.

On April 27 of that year, the Canadian Pacific steamer ***Empress of Britain*** docked in Halifax Harbor, and its skipper, Captain Murray, reported meeting many icebergs. On the 24th, the ***Empress*** had nearly repeated the ***Titanic***'s experience. Although the night was foggy, the iceberg was seen in enough time to avoid a collision. The engines were reversed at full speed, and the ship came to a stop only a few yards away from the mountain of ice. Few of the passengers on board realized how close they came to repeating the disaster that occurred 2 weeks earlier. On May 4th, the Newfoundland coastal steamer ss ***Erik*** also came within yards of colliding with an iceberg.

More shipwrecks followed. An incident similar to the ***Arctic*** disaster occurred June 19, 1924. The 12,000-ton Canadian Pacific liner ss ***Metagama*** collided with the Italian freighter ***Clara Camus*** in a dense fog off Cape Race. The ***Metagama*** took on water but manage to limp into the port of St. John's. Luck was not with the vessel as shortly after leaving St. John's after repair, the ***Metagama*** grounded on a reef.

Cape Race also took part in the rescue of the 29,000-ton Italian liner ***Andrea Doria*** which sank



Philip Dattilo

after colliding with the Swedish liner ***Stockholm***. Both ships were traveling through heavy fog at the time.

When Canada replaced British rule, the new government realized that a strong light was needed on this disaster-prone point. The 1907 lighthouse contained a cylindrical tower of reinforced concrete standing 96 feet high. The old light had been rated at 6,000 candlepower compared to the newer structures' at 1,100, 000. This light's optical apparatus was (and still is) one of the largest of its kind ever constructed for a lighthouse. The diameter of the four optical faces was over 8 feet and composed of reflecting prisms and projecting lenses which revolved clockwise at a rate of one revolution every 30 seconds. To retain the correct speed and steadiness, the whole optical apparatus was mounted on a cast-iron table which floats in a bath containing 950 pounds of mercury. The original light was transported to Cape North, Nova Scotia where it was reassembled. In 1981, the light was recognized for its historical significance and moved to Ottawa where it stands at the National Museum of Science and Technology.

The drama of the ***Titanic*** sinking continued long after that April evening in 1912. Years later Tom Myrick, cousin of the young wireless apprentice who worked the night of the disaster, recounted an event that resulted in the loss of important records of the ***Titanic*** disaster.

All the messages received from the ***Titanic***, both before and after the collision with the iceberg, were written on green cards and saved in a large box on the premises. In 1943, a new operator was doing some general housecleaning when he came upon a dusty old box containing all the out-of-date ship-to-shore messages. All the operator saw was the year and the messages from passengers to friends and relatives. He did not see the ***Titanic***'s name or the memorable date.

Not realizing the importance of what he held in his hands, he threw 2 weeks of recorded history over the cliff. Myrick was the other operator at the time and had known the box's contents. He blamed himself for not taking the box home with him, and when he learned what had happened, he remembered he felt like throwing the guy down after the messages. Thus another piece of history from April 12, 1912 is lost forever.

Cape Race Remains

Despite its history Cape Race still provides services to the mariner. A few miles northeast of the cape, a Loran-C (Long Range Aid to Navigation) towers stands, providing navigation fixes to any ship or aircraft that requires its services. The tower's operation is a joint effort by both the Canadian and the U.S. Coast Guard. The lighthouse remains but keepers no longer reside at the cape. Instead two keepers work 30-day shifts. In the late 1970s Cape Race was honored by the Canadian government for its role in the safety of Atlantic shipping, and it was designated a National Historic Site.

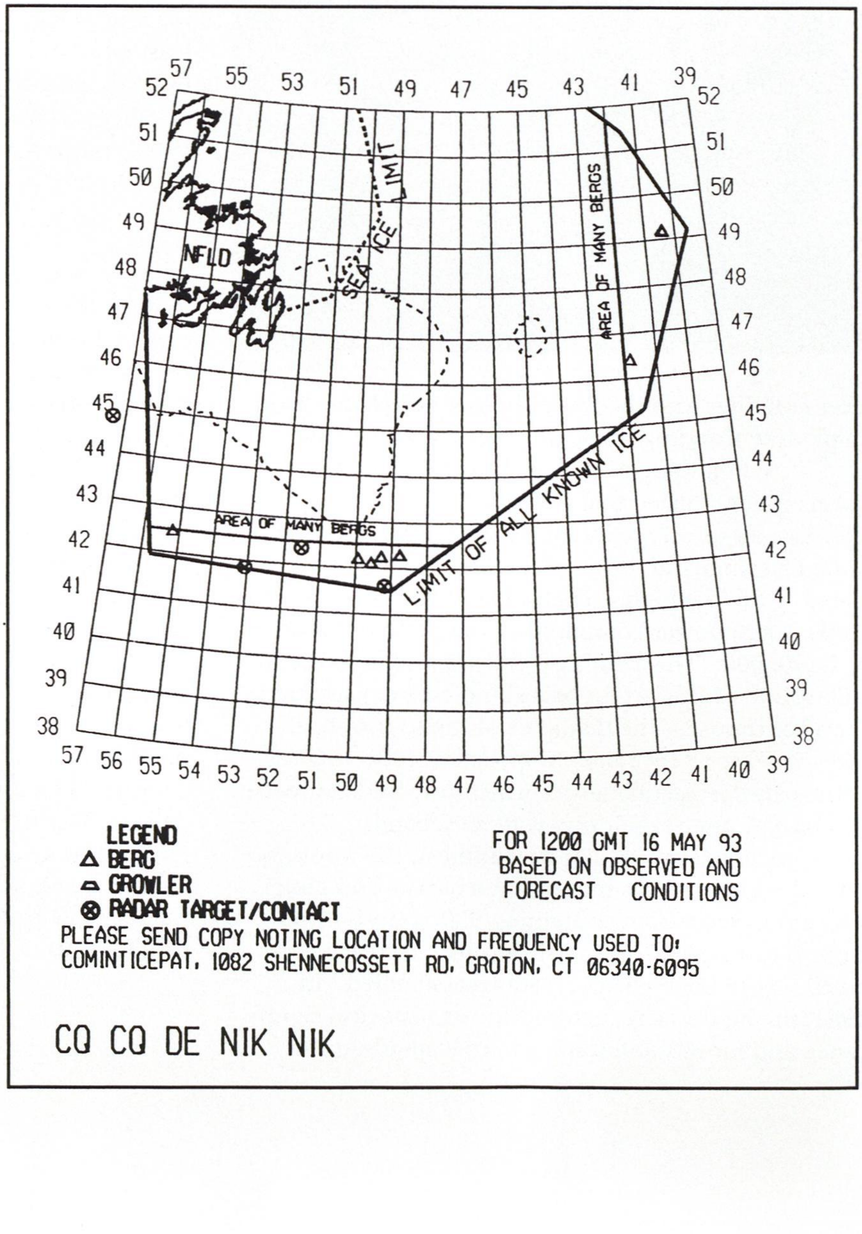
Only one structure remains of the many buildings present on the night of that famous marine tragedy. Today, Cape Race is in some respects even more lonely and isolated than it was at the turn of the century. The only sounds to be heard are those of the Atlantic Ocean beating against the rocky shore. Perhaps on some cold April night, one can imagine the sounds that crackled through the atmosphere– the faint signals from far out in the Atlantic: CQD...CQD...CQD...CQD...MGY....

The International Ice Patrol '94

Lt. Robert Haines
U.S. Coast Guard

Soon after the Titanic's tragic collision with an iceberg in April of 1912, the International Safety of Life at Sea (SOLAS) convention met. SOLAS called for the establishment of an ice patrol in the North Atlantic Ocean to prevent the recurrence of a similar tragedy, and the U. S. Coast Guard has been tasked with conducting that ice patrol since 1914. Over the past 79 years the Coast Guard International Ice Patrol (IIP) has had a perfect record, with not a single loss of life or instance of property damage due to collision with an iceberg outside IIP's advertised limit of all known ice. Shipping in the Grand Banks area has traditionally been a valuable source of iceberg sightings, and the IIP depends heavily on the assistance of mariners for these sighting reports in their operations area (40°- 52°N, 39°- 57°W).

The Grand Banks region is inside the transatlantic shipping lanes and contains very rich fishing grounds. For some vessels, economics dictate that they sail inside the limits of all known ice. Unfortunately, this region is noted for its heavy fog, and even with the advent



of modern marine radar, ships may not *see* all the icebergs. During the 1993 ice season, three ships collided with icebergs within the limits of all known ice as defined by IIP. Glacial ice on the Grand Banks has a reflection coefficient of about 0.33, and reflects radar waves 60 times less than a ship of equivalent size and cross section. Therefore, an iceberg the size of a large fishing vessel may only reflect radar as well as a small sailboat, and growlers (weighing up to about 100 tons) may be virtually undetectable even with expert use of anti-clutter filters. In addition, the prevailing weather conditions on the Grand Banks during the ice season (i.e., dense fog, high seas and precipitation) degrade radar performance even more and make visual iceberg detection virtually impossible.

IIP flies ice reconnaissance detachments on radar-equipped long- and medium-range search aircraft during the iceberg season, which usually runs from March through August. The all-weather, side-looking radar carried on the aircraft helps find small icebergs and even growlers in poor visibility. In 1991 and again in 1993, IIP evaluated a forward-looking radar that is able to image icebergs, and aids in discriminating icebergs from vessels. The aircraft fly out of St. John's, Newfoundland every other week during the iceberg season. Even with aircraft, however, the large size of the IIP operations area precludes 100% coverage of the entire iceberg infested area, and our reconnaissance is concentrated at the southern and eastern limits of the icebergs. We aim to keep track of these *limit setters*. IIP does not want to encourage vessels to transit through areas containing icebergs, but we depend heavily on the assistance of shipping in the Grand Banks area for iceberg and sea surface temperature reports within our operations area. Reports of stationary radar targets, which often turn out to be large or medium icebergs, are also important. In 1993, 18.3% of the iceberg sightings, or 1,475 individual reports, came from shipping. These vessel sighting reports are tremendously important because they allow IIP to begin tracking icebergs before they are near the limits of all known ice, and verify the positions of icebergs already being tracked.

Reporting ships are requested to provide the following information: ship name and call sign, position of any ice sighted (or vessel position if no ice sighted), time of sighting, sighting method (visual, radar or both), size and shape of iceberg, sea ice concentration and thickness, and sea surface temperature. Negative sighting

Denis Arseneault

*The m/v **Cast Polarbear** was awarded a plaque for the most frequent participation in the International Ice Patrol Program for the 1991/92 season. Presenting the award in Montreal, Canada in July 1993 on behalf of the U.S. Coast Guard, is Captain Rudolph Tchadej (Canadain Coast Guard) on the left. Accepting the award are Commanding Officer Captain Rasim Dapo (center) and Michael A. Mills (agent for the Cast Company).*

reports with visibility limits are just as important as positive ones. These reports can be made to any Canadian Coast Guard Marine Radio Station or U. S. Coast Guard Communications Station on the frequencies listed in Pub. 117 (Radio Navigational Aids), or directly to IIP using INMARSAT code 42 at no cost. All iceberg sighting reports are forwarded to the IIP Operations Center in Groton, Connecticut where they are entered into a computer model that predicts iceberg drift and melt. The model helps watchstanders determine whether reports are new sightings or resightings of previously reported icebergs. The model output is used to determine the limit of all known ice and is broadcast out to mariners twice each day as an Ice Bulletin, and once per day in radiofacsimile form.

It is extremely difficult, if not impossible, to predict what any given ice season will be like. The 1993 ice season started in February, almost a month earlier than normal. IIP saw extreme limits to the south and east very early in the year, with more icebergs than normal in the operations area, but in July the limits rapidly collapsed back to the north, and the season ended by the beginning of August. The extreme unpredictability of the ice season characteristics from year to year is one of the things that makes ship reports so valuable. The earlier IIP finds out about unusual ice conditions, the better. Ships have been and will continue to be a very valuable source of information and IIP encourages all mariners to continue to send ice reports in the future.

INTERNATIONAL ICE PATROL BROADCASTS

BROADCAST STATION	TIME OF BROADCAST (UTC)	FREQUENCIES (kHz)
NAVTEX BROADCASTS		
Coast Guard Communication Station Boston/NIK	0445, 0845 1245, 1645 2045, 0045	518
Canadian CG Radio Station Sydney/ZCO	2240	518
NBDP (FEC) BROADCASTS		
Coast Guard Communication Station Boston/NIK	0030 1218	6314, 8416.5, 12579 8416.5, 12579, 16806.5
CW BROADCASTS		
Coast Guard Communication Station Boston/NIK (Bcst to follow NBDP bcst)	0050 1250	5320, 8502, 12750 8502, 12750
Canadian CG Radio Station St. John's/VON	0000 1400	478
Canadian Forces METOC Centre Halifax/CFH	0015, 1101 1301, 1401 2201, 2301	122.5 Cont. (off air 1200-1600 2nd Thurs. each month) 4271 (2200–1000 UTC) 6496.4 Cont. 10536, Cont.,13510 (1000-2200 UTC)
Canadian Coast Guard Radio Station Halifax/VCS	1330 2200	4285, 6491.5, 8440 12874, 16948, 22619.5 (Broadcast on frequencies as advertised by CN marker tape.
LCMP BROADCASTS		
Norfolk, VA NMN/NAM/NAR	0800–0900 1500–1600 1600–1700 2100–2200	8090, 12135, 16180 8090, 12135, 16180, 20225 8090, 12135, 16180, 20225 8090, 12135, 6180, 20225
Key West, FL/NAR	0800–0900 1500–1600 1600–1700 2100–2200	5870 5870, 26725 5870, 26725 5870, 26725

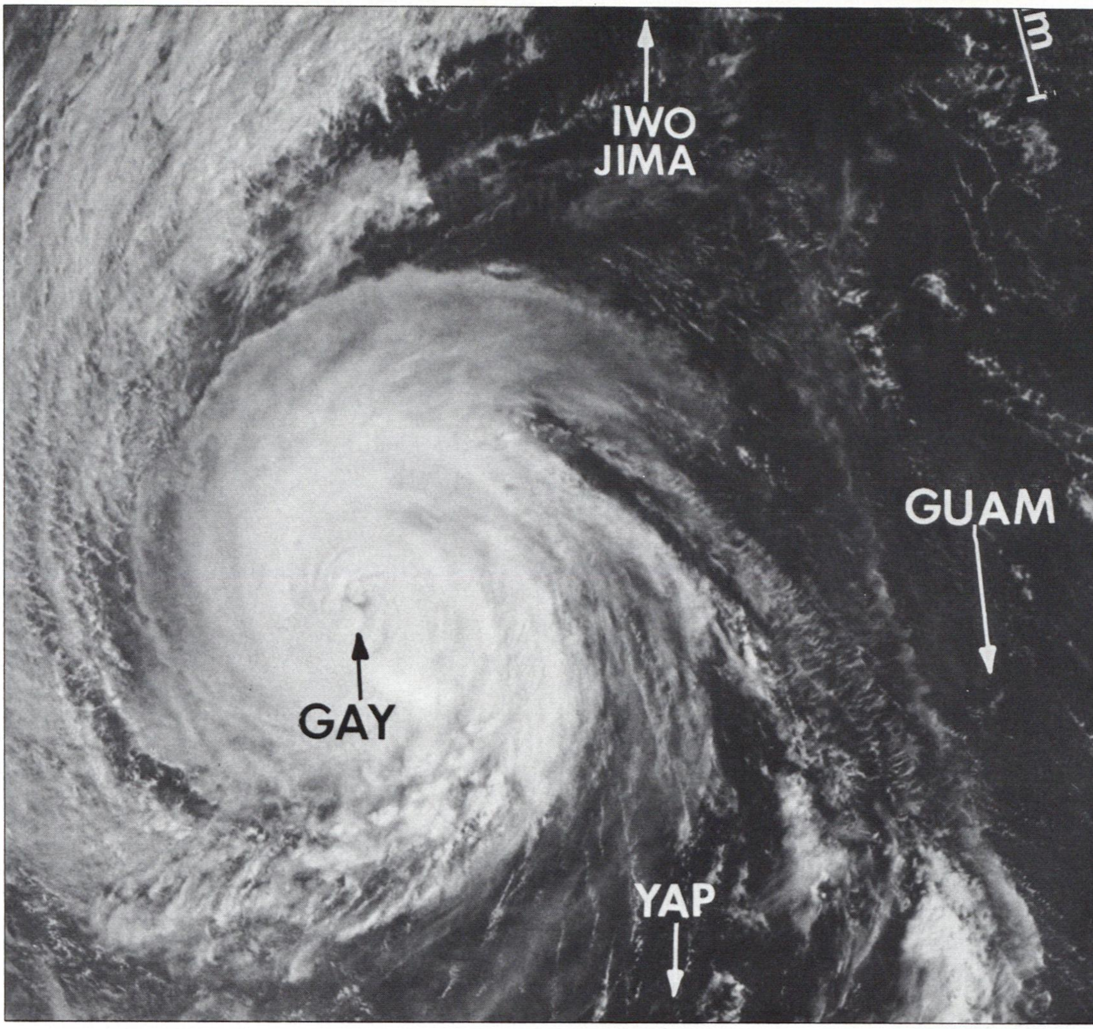
BROADCAST STATION	TIME OF BROADCAST (UTC)	FREQUENCIES (kHz)
RADIOFACSIMILE BROADCASTS		
Coast Guard Communication Station Boston/NIK	1600	8502, 12750(+/- 400 Hz)
BROADCAST STATION	TIME OF BROADCAST (Z)	FREQUENCIES (kHz)
Radio Station Bracknell, Great Britain/GFE (Eastern North Atlantic Sea Ice Observations)	1602 Cont.; 14436	2618.5 (1800-0600, Oct. 1–Mar 31; 1900-0500, Apr 1-Sep 30); 4782 Cont.; 9203 Cont;18261 (0600-1800 Oct 1 – Mar. 31; 0500-1900 Apr. 1 - Sept.30)
Canadian Forces METOC Cen. Halifax/CFH (Primarily sea ice in Gulf of St. Lawrence and North. Limits of icebergs sometimes given.	0015, 1101 1301, 1401 2201, 2301	122.5 Cont., (off air 1200-1600 second Thurs. each month); 4271 (2200-1000 UTC); 6496.4 Cont.; 10536 Cont.; 13510 (1000–2000 UTC)

COMSAT BROADCASTS

The 00Z and 12Z Ice Bulletins will be broadcast over the AOR-W Satellite at 00z and 12Z daily. Safety broadcasts made by the International Ice Patrol regarding icebergs outside of the limits of All Known Ice will only be made over the AOR–W–Satellite.

RADIO TELEX		
Canadian Coast Guard Marine Radio Station Halifax/VCS	0630 1630 2300	4213.5 8419.5 4213.5
RADIO TELEPHONE		
Canadian Coast Guard Marine Radio Station Halifax/VCS	1335 2335	4408, 8785, 13113
SPECIAL BROADCASTS		
Canadian CG Radio Station St. John's/VON	As required when icebergs are sighted outside the limits of ice between regularly scheduled broadcasts.	2598 Radiotelephone preceded by Inter-Safety Signal (SECURITE) on 2182 kHz. 478 (CW) Preceded by International Safety Signal (TTT) on 500 kHz.
Coast Guard Communication Station Boston/NIK	As required when ice–bergs are sighted outside the limits of ice between regularly scheduled broadcasts. NAVTEX upon receipt or first available BCST window. NBDP (FEC) next scheduled BCST.	472 (CW) preceded by International Safety Signal (TTT) on 500 kHz.
International Ice Patrol Vessel/NIDK (when assigned) on 2182 kHz.	When in the vicinity of ice in periods of darkness or fog.	2670 Preceded by International Safety Signal (SECURITE)

WESTERN NORTH PACIFIC TYPHOONS 1992



STAFF, JOINT TYPHOON WARNING CENTER

The 1992 typhoon season in the western North Pacific was notable for Super Typhoon Gay the most intense typhoon since Typhoon Tip in October 1979. Also of importance was the pounding suffered by the island of Guam at the hands of Omar, Brian and Gay.

A total of 33 tropical cyclones were recorded in the western North Pacific in 1992. This was two more tropical cyclones than the long-term annual mean of 31. As in the previous 2 years, one additional significant tropical cyclone, Ekeka, moved westward across the central North Pacific into the Joint Typhoon Warning Center's (JTWC's) area of responsibility and was included in the totals. This year included five super typhoons, 16 lesser typhoons, 11 tropical storms and one tropical depression. JTWC was in warning status 159 days during 1992 compared to 169 in 1991. Although there were less total warning days, an increase in the number of multiple storm days resulted in a greater total number of warnings– 941 compared to 835 the previous year.

This summary is based upon the 1992 Annual Tropical Cyclone Report prepared by the Joint Typhoon Warning Center, Guam, Mariana Islands. Our thanks to Captain Donald A. Mautner (U.S. Navy), Lieutenant Colonel Charles P. Guard and their staff.

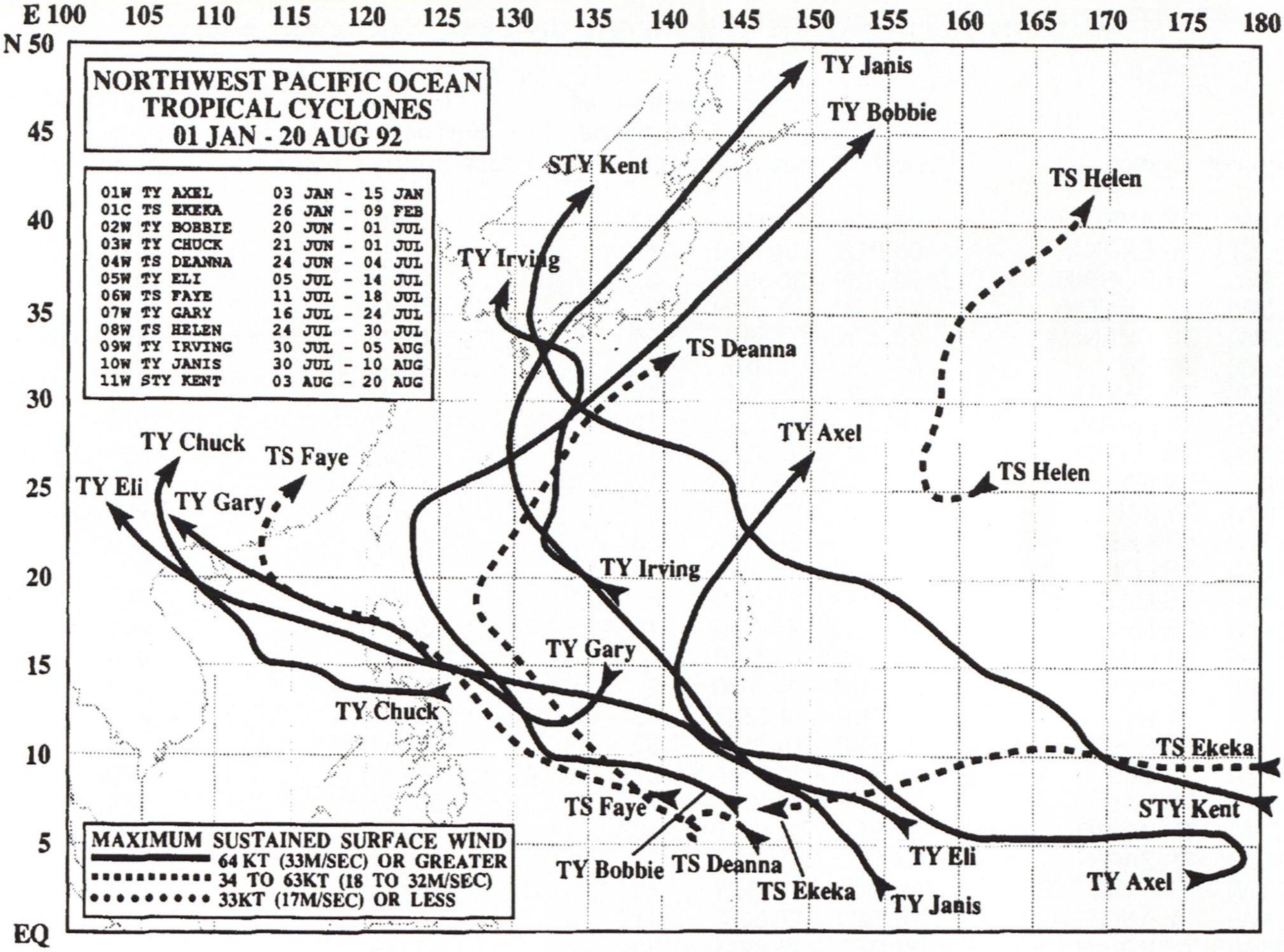
Western North Pacific Significant Tropical Cyclones, 1992

Tropical Cyclone		Period of Warning	Number of Warnings Issued	Maximum Surface Winds knots (meters/second)	Estimated MSLP millibars
(01W)	TY AXEL	05 JAN – 15 JAN	38	70 (36)	972
(01C)	TS EKEKA	05 FEB – 08 FEB	19	45 (23)	991
(02W)	TY BOBBIE	23 JUN – 30 JUN	27	120 (62)	922
(03W)	TY CHUCK	25 JUN – 30 JUN	22	80 (41)	964
(04W)	TS DEANNA	26 JUN – 03 JUL	24	40 (21)	994
(05W)	TY ELI	09 JUL – 14 JUL	18	75 (39)	968
(06W)	TS FAYE	16 JUL – 18 JUL	11	55 (28)	984
(07W)	TY GARY	19 JUL – 23 JUL	19	65 (33)	976
(08W)	TS HELEN	26 JUL – 28 JUL	9	45 (23)	991
(09W)	TY IRVING	01 AUG – 05 AUG	17	80 (41)	975
(10W)	TY JANIS	03 AUG – 09 AUG	27	115 (59)	927
(11W)	STY KENT	05 AUG – 20 AUG	58	130 (67)	910
(12W)	TS LOIS	15 AUG – 22 AUG	28	40 (21)	994
(13W)	TS MARK	15 AUG – 21 AUG	21	50 (26)	987
(14W)	TS NINA	18 AUG – 21 AUG	13	45 (23)	991
(15W)	STY OMAR	24 AUG – 05 SEP	50	130 (67)	910
(16W)	TS POLLY	25 AUG – 30 AUG	21	50 (26)	987
(17W)	TY RYAN	01 SEP – 11 SEP	43	115 (59)	927
(18W)	TY SIBYL	07 SEP – 15 SEP	32	110 (57)	933
(19W)	TY TED	18 SEP – 24 SEP	27	65 (33)	976
(20W)	TS VAL	23 SEP – 27 SEP	15	55 (28)	984
(21W)	TY WARD	26 SEP – 06 OCT	40	95 (49)	949
(22W)	TS ZACK	07 OCT – 15 OCT	27	40 (21)	993
(23W)	STY YVETTE	08 OCT – 17 OCT	40	155 (80)	878
(24W)	TY ANGELA	16 OCT – 29 OCT	41	90 (46)	954
(25W)	TY BRIAN	17 OCT – 25 OCT	33	95 (49)	949
(26W)	TY COLLEEN	18 OCT – 28 OCT	44	80 (41)	963
(27W)	TY DAN	24 OCT – 03 NOV	40	110 (57)	927
(28W)	STY ELSIE	29 OCT – 07 NOV	36	145 (75)	892
(29W)	TD 29W	01 NOV – 02 NOV	3	25 (13)	1002
(30W)	TS FORREST	12 NOV – 15 NOV	12	55 (28)	984
(31W)	STY GAY	14 NOV – 30 NOV	63	160 (82)	872
(32W)	TY HUNT	16 NOV – 21 NOV	23	125 (64)	916

JANUARY THROUGH MAY

Due to warm sea-surface temperature anomalies in the central equatorial Pacific Ocean, January was a month where westerly low-level wind anomalies extended from New Guinea eastward into the Central Pacific Ocean and aided the development of Typhoon Axel in the western North Pacific, a twin tropical cyclone in the Southern Hemisphere, and in late January, the formation of Ekeka. Axel, the first significant tropical cyclone to occur in 1992 in the western North Pacific, developed in the first week of January in conjunction with Betsy, and later Mark in the Southern Hemisphere, in response to an equatorial west wind burst to the east of New Guinea. Axel's early intensification at a low latitude proved particularly damaging to the Marshall and eastern Caroline Islands. During the last week of January, Ekeka, which formed south of the Hawaiian Islands, became a rare January central North Pacific hurricane. Due to increasing upper-level wind shear, Ekeka had weakened to 40 knots when the JTWC assumed warning responsibility on February 4. The weakening tropical cyclone continued to move westward and passed through the Marshall Islands.

Gay's cloud-filled eye is visible (page 34) as the typhoon approaches its second peak intensity. The circulation is large which is typical of November typhoons. DMSP visual imagery at about 2348 UTC on November 24, 1992.

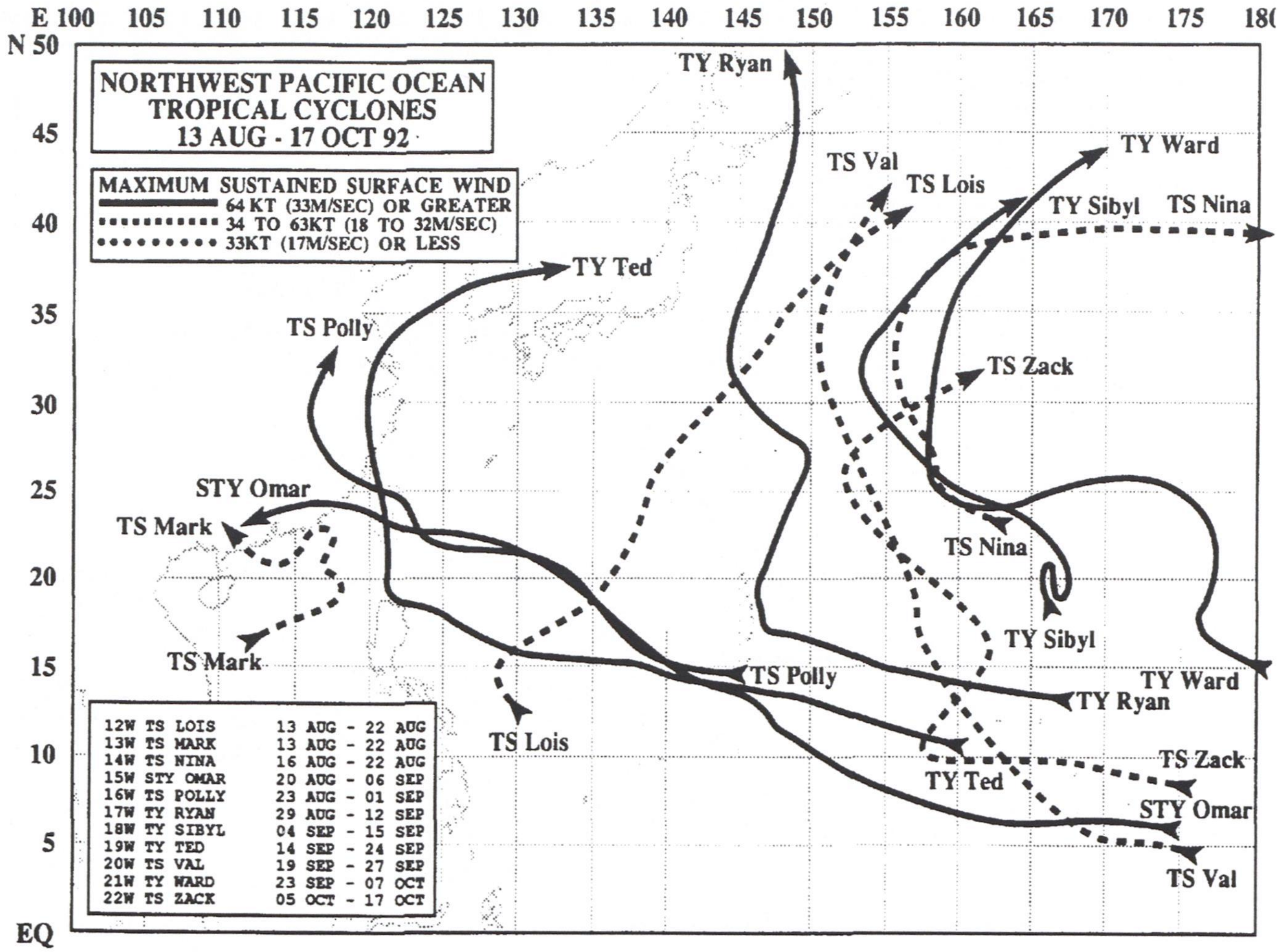


JUNE

After a 4-month hiatus in tropical cyclone activity, Bobbie developed in the monsoonal trough in the central Caroline Islands in late June. Bobbie's formation coincided with that of Chuck's over the central Philippine Islands, and the two underwent binary interaction for 3 days. As Typhoon Bobbie passed east of northern Luzon, torrential rains, associated with the deep monsoonal flow into Bobbie and enhanced by Chuck, caused heavy rains, mudslides, and widespread flooding over the northern half of the Philippines. Bobbie accelerated after recurving and tracking just to the southeast of Okinawa and underwent extratropical transition before passing just south of Tokyo. Chuck was the first significant tropical cyclone of the year in the South China Sea. Deanna executed a counterclockwise loop on June 27–28 in the western Caroline Islands before moving out to the northwest on a track parallel to the one taken by Bobbie 5 days earlier.

JULY

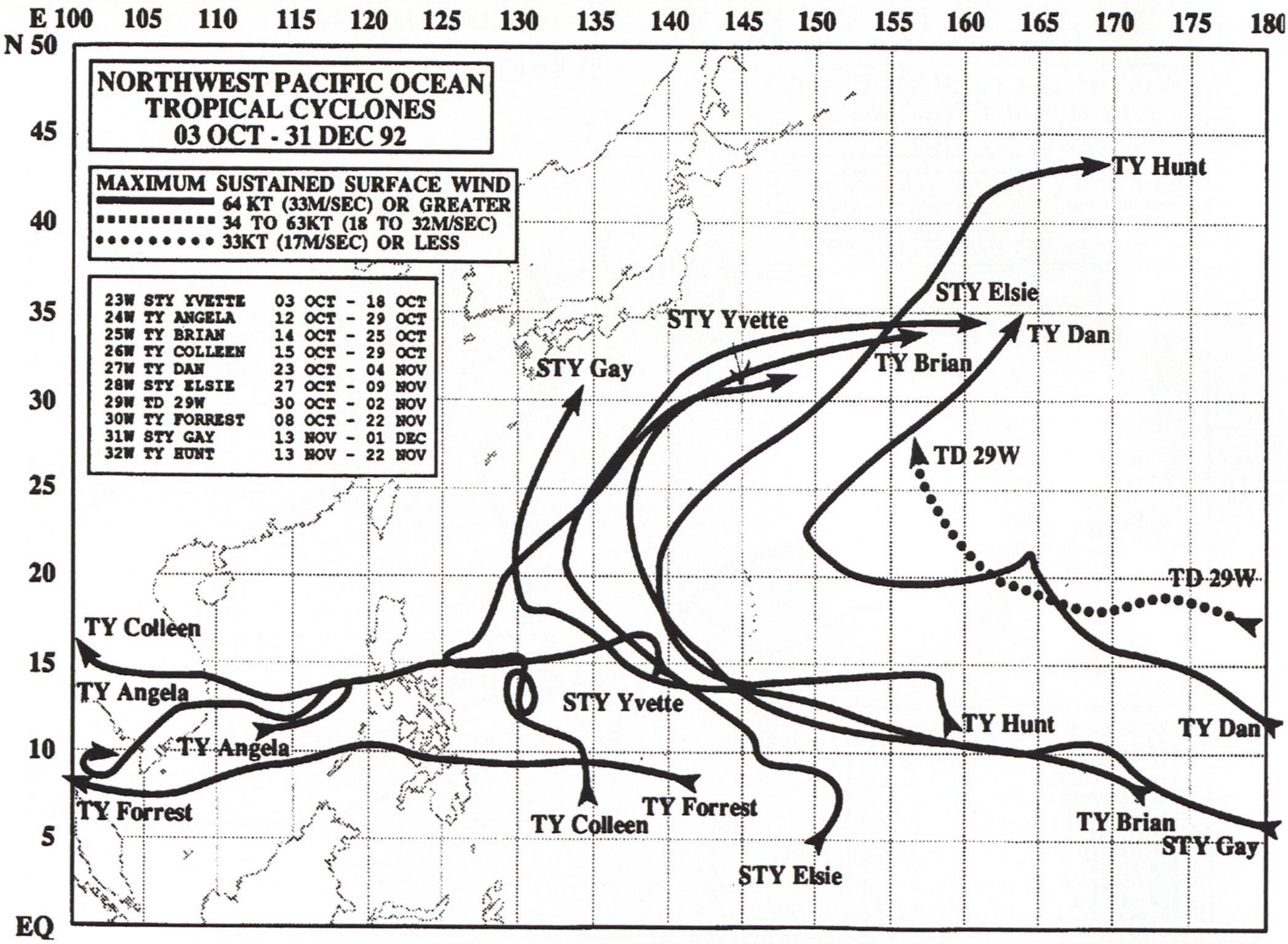
After Deanna recurved on July 2, ridging temporarily replaced the monsoonal trough across the northern Philippine Islands and Philippine Sea. Weak southwesterlies, however, persisted at low latitudes and Eli formed in the eastern Caroline Islands. Slow to intensify, Typhoon Eli tracked rapidly west northwestward across Luzon, the South China Sea, and into northern Vietnam. Some 25 fishermen were reported missing off the east coast of Luzon. Faye was the second of three successive tropical cyclones to pass over northern Luzon and intensify in the South China Sea. Recurving south of Hong Kong on July 17, Faye proceeded north northeastward into China and dissipated. Gary followed Faye and struck the southern coast of China near Hainan Dao. Gary caused widespread damage and at least 26 deaths across southern China. Helen intensified from a Tropical Upper Tropospheric Trough (TUTT)-induced low-level circulation. The tropical storm began to weaken as it gained latitude and moved into a region of cooler sea-surface temperatures. A few days later, Irving became the first of two successive typhoons to affect southwestern Japan. It



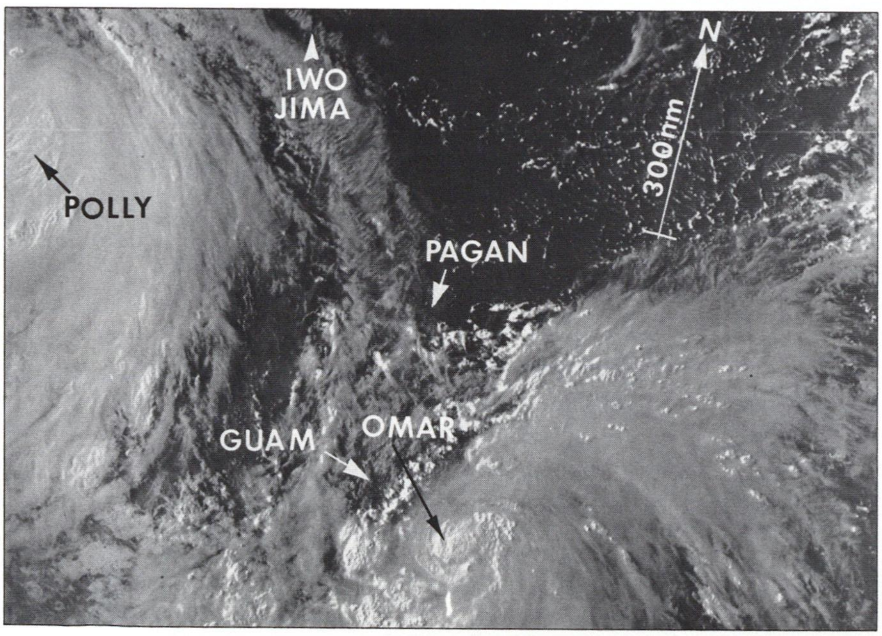
formed at the eastern end of the monsoonal trough where several low-level vorticity centers were embedded in a broad area of poorly organized convection. Irving slowly intensified and took a northerly track into southwestern Japan followed by westward motion toward Korea due to the reestablishment of the mid-level subtropical ridge.

AUGUST

Four days after Irving hammered Shikoku, Janis slammed into Kyushu. Janis began near Pohnpei in the Caroline Islands, took a northwestward track threatening Okinawa, then recurved, passed over Kyushu, and skirted the western coast of Honshu. As Janis passed east of Taiwan, one fisherman was killed when 8-meter (26 foot) waves sank five fishing boats. Janis turned extratropical over Hokkaido. Kent became the first super typhoon of 1992. During its trek toward Japan, Kent underwent binary interaction with Tropical Storm Lois. Kent was second only to Super Typhoon Gay for longevity in 1992. Lois was one of only two tropical cyclones in 1992 which had a persistent eastward component of motion during its period of warning. The storm bedeviled JTWC forecasters by consistently moving counter to the climatologically expected motion. After escaping the binary interaction with Kent, Lois accelerated northeastward and dissipated over colder water. Mark was part of a multiple storm outbreak with Kent, Lois, and later, Nina. On August 15, Mark's genesis in the South China Sea in the monsoonal trough coincided with Lois' in the Philippine Sea, as deep low-level southwesterly flow surged eastward across the Philippine Islands. Due to strong vertical wind shear, Mark was slow to intensify. It dissipated over southern China. Nina formed as a TUTT-induced tropical cyclone under divergent upper-level flow east of Kent. Nina's winds intensified to a peak of 45 knots despite the strongly sheared environment. On August 20, the second super typhoon of 1992, Omar developed in the southern Marshall Islands, moved steadily west northwestward and intensified. Omar wreaked havoc on Guam on the 28th as it rapidly intensified just prior to passing directly over the island. Omar was

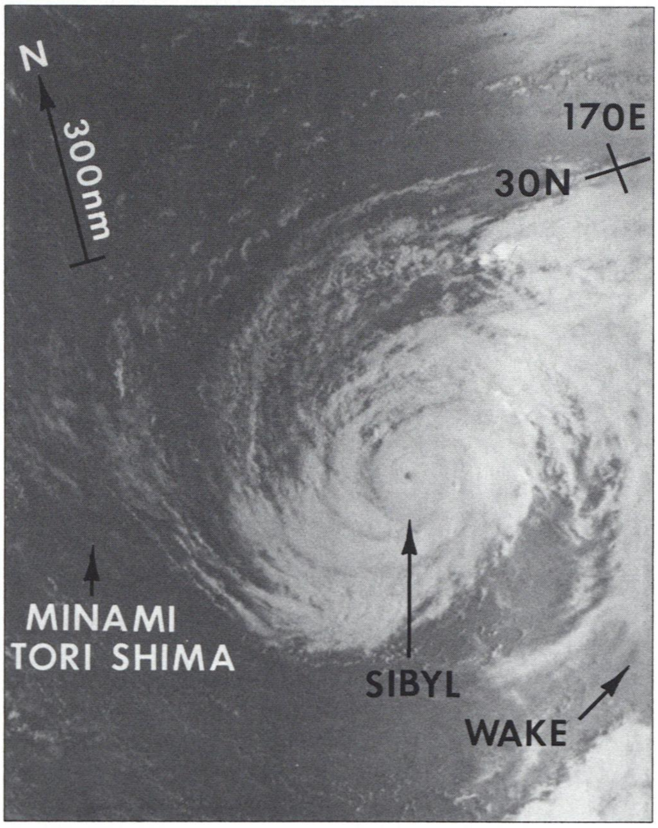


the most damaging typhoon to strike Guam since Typhoon Pamela in 1976, causing an estimated $457 million of damage. Because they could not sortie, two of the Navy's supply ships, the USS *Niagara Falls* and USS *White Plains* went aground in Apra Harbor after they broke moorings. Omar continued onward into the Philippine Sea where it briefly attained super typhoon intensity. It then steadily weakened, passing over Taiwan as a tropical storm, and dissipated over southeastern China. Polly developed along with Omar as part of a major relocation of the monsoonal trough. Polly was unusual in that throughout most of its life, it maintained the structure of a monsoon depression with a ring of peripheral gales and a broad band of deep convection around a large, relatively cloud free, central area of light-and-variable winds. The outflow aloft from Polly appeared to play an important role in delaying the intensification of Omar when Omar was approaching Guam. Although Polly never reached typhoon intensity, it did have quite an impact on eastern Asia.



SEPTEMBER

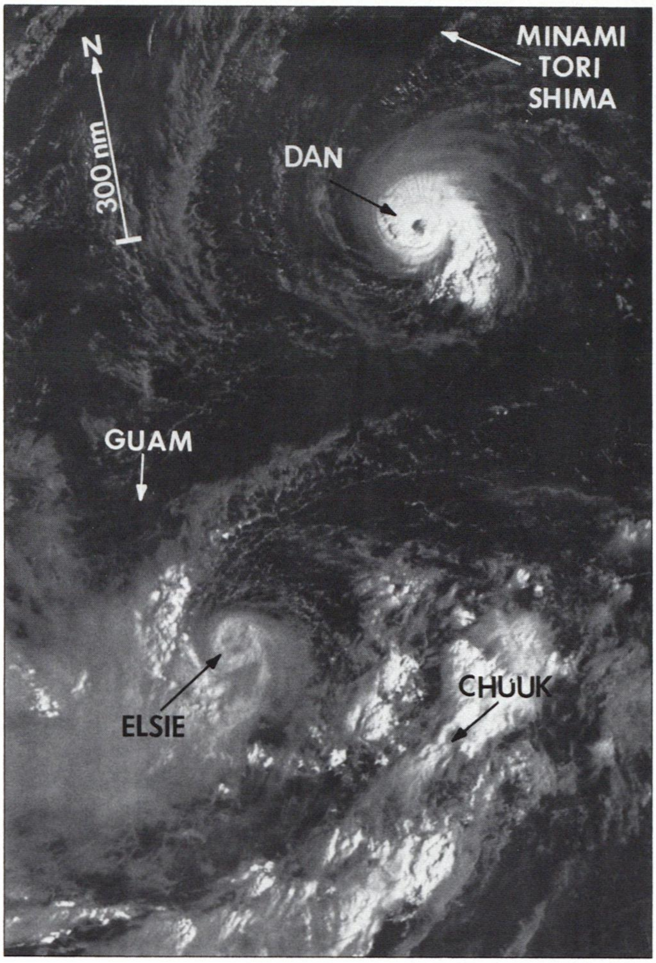
The first of five significant tropical cyclones to form in September, Ryan became part of a multiple storm outbreak, including Omar and Sibyl, east of 150°E. Although Ryan initially took a west northwestward course, it later stalled and then moved in a northerly direction. Two days after turning extratropical east of Hokkaido, the remnants of Ryan could still be identified as an occluded low continuing northward over Siberia, north of the Sea of Okhotsk. Sibyl, like Ryan, formed at the extreme eastern end of the monsoonal trough. But unlike Ryan, Sibyl underwent a complex interaction with a cyclonic cell in the TUTT, and later recurved. For 5 days, Sibyl exhibited erratic motion and slowly intensified near Wake Island, before moving toward the northwest and recurving. Ted was marked by moderate to strong upper-level wind shear throughout most of its life. A combination of shearing effects and land interaction prevented Ted from intensifying above minimal typhoon strength. Ted's tour of Asia included northern Luzon, northeastern Taiwan, eastern China and finally Korea before the circulation transformed into a weak extratropical cyclone over the Sea of Japan. Val was the only one of five typhoons in September that did not intensify beyond a tropical storm. Like Ted, which formed a day earlier on the 18th, Val was slow to intensify. Ward formed in the trade wind trough just to the east of the International Dateline. The storm presented considerable difficulty to JTWC forecasters, as it underwent two major track changes and two significant acceleration episodes.



Omar's convection begins to coil tightly as the typhoon starts to accelerate toward Guam. The outflow from Polly to the northwest is starting to weaken. This DMSP visual imagery (lower left) was shot on August 27, 1992 at 0709 UTC. Typhoon Sybil finally moves away from Wake Island. Photograph (above) is a NOAA visual image taken on the 10th of September at 2133 UTC.

OCTOBER

The first of eight significant tropical cyclones to form in October, Zack initially moved west northwestward, but a monsoonal surge of deep southwesterly winds resulted in an abrupt track change toward the north northeast. As the tropical storm weakened, the low-level circulation center became difficult to locate on the 12th. However, by the following day, the convection and organization of the system had increased, prompting JTWC to issue a "regenerated" warning. Zack briefly reintensified to a tropical storm before becoming subtropical and dissipating. The third Northwest Pacific tropical cyclone of 1992 to achieve super typhoon intensity was Yvette. It formed at the same time as Zack and proved to be an action-packed system which posed many forecast challenges. In the span of 2 weeks, Yvette developed in a moderately sheared environment, made a run toward Luzon as it intensified to a typhoon, stalled, executed a major, 150-degree track change, weakened, reintensified to a super typhoon, and became an extratropical cyclone. During the second week of October, Angela developed in the South China Sea, moved eastward, reversed course and struck southern Vietnam. Angela later crossed southern Indochina and reintensified to a severe tropical storm in the Gulf of Thailand, where it tracked through a clockwise loop, and finally dissipated over the Gulf. Angela posed a significant threat in the Gulf of Thailand, where manned gas platforms were evacuated as the storm intensified and moved into the area. Forming in the southern Marshall Islands, Brian moved west northwestward and intensified into a midget typhoon as it passed across Guam—their second eye passage in less than 2 months. Later, Brian underwent binary interaction with Typhoon Colleen, subsequently recurved, and finally became extratropical. Colleen developed from a broad cyclonic circulation in the monsoon trough between Typhoon Angela to the west and Typhoon Brian to the east. Binary interaction occurred between Colleen and Brian, causing Colleen to make a slow



Above, Typhoon Dan is nearing its second peak and is involved in a binary interaction with Typhoon Elsie, which is visible to the southwest on this DSMP visual image taken at 2258 UTC on the 31st of October.

anticyclonic loop in the Philippine Sea before turning westward. After crossing Luzon, Colleen reintensified into a typhoon before slamming into central Vietnam and dissipating inland. On October 21, the Korean iron ore bulk carrier, ***Daeyang Honey*** was reported missing in the Philippine Sea. A 9-day search effort involved the U.S. Navy's VQ-1 Squadron on Guam and VP-6 Squadron from Okinawa, U.S. Coast Guard's Marianas Rescue Coordination Center (Guam), Japan Maritime Safety Agency, and Pan Ocean Shipping. Floating debris was ultimately found, but there was no sign of the 28 crew members. Dan became the most destructive typhoon to strike Wake Island in the past quarter century, causing an estimated $9.0 million in damage. Like Ekeka and Ward, Dan formed east of the International Dateline, marking the first time that three significant tropical cyclones were observed to cross into the JTWC's area of responsibility from the central North Pacific during a single year. Later, Dan took a west southwesterly course, reintensified, and finally, underwent a binary interaction with Typhoon Elsie before recurving sharply. The fourth super typhoon of 1992, Elsie, which was the third typhoon to pass within 60 miles (100 kilometers) of Guam in less than 3 months. After a series of erratic moves and an interaction with Typhoon Dan, Elsie settled down on a track toward the northwest, recurved, and transformed into a hurricane-force extratropical low.

NOVEMBER AND DECEMBER

Forming in the wake of Typhoon Dan, Tropical Depression 29W immediately became a threat to Wake Island. Fortunately, the Tropical Depression's intensification was severely curtailed by the persistent outflow from Dan. Forrest became part of a three storm outbreak along with Gay and Hunt. Forrest was the only tropical cyclone of 1992 to track from the western North Pacific, across the South China Sea, and into the Bay of Bengal. It reached a maximum intensity of 125 knots (64 meters/second) in the Bay of Bengal. The day after Forrest became a tropical storm, Hunt developed and became the fourth typhoon to pass within 60 miles (110 kilometers) of Guam in less than 3 months. As Hunt intensified, it brushed by Guam, moved into the Philippine Sea, and later recurved. After recurvature, the typhoon played an important role in the extremely rapid weakening of Super Typhoon Gay which was approaching the southern Mariana Islands. Gay developed at the same time as Hunt. Gay was noteworthy for five reasons: its eye became the record third to pass across Guam in less than 3 months; it was estimated to be the most intense tropical cyclone to occur in the western North Pacific since Super Typhoon Tip in October of 1979; it went through two intensification periods, which is not rare but is relatively uncommon; it filled an estimated 99 millibars in less than 48 hours without moving over land; and, it required the highest number of warnings, 63, for any western North Pacific tropical cyclone in 1992. Four days after being detected as a tropical disturbance, Gay slammed into several of the Marshall Islands with typhoon-force winds. After peaking with sustained winds of 160 knot (82 meter/second) with gusts to 195 knots (100 meters/second), the super typhoon weakened for 2 days before reaching Guam. Typhoon Gay passed across the center of Guam on November 23, then reintensified to a second peak before recurving on November 30, and dissipating over water south of Japan. No significant tropical cyclones occurred in the western North Pacific in December.

What Caused the Freak Waves Along the Florida East Coast in July of 1992?

Jerome W. Nickerson

A check of seismographic and sonar records revealed no earthquakes or underwater landslides occurred to explain the freak waves that moved ashore along the east coast of Florida on July 3, 1992. The National Weather Service Office at Daytona Beach offered some radar scope plots that showed a few radar echoes that could have been thunderstorms southeast of Jacksonville. They used the downburst Extreme Storm Wave theory suggested by the author for an explanation. Right theory–wrong storm.

The meteorological data, including satellite photographs, synoptic charts and ship reports indicated an Arctic cold air outbreak had plunged southeastward from Hudson Bay, Canada, across the Canadian Maritimes, the northeastern U.S. and into the Atlantic on July 2. Once over the Atlantic, it spread rapidly in all directions. A cold air outbreak of this intensity is very rare in the summer. But weatherwise this had been an unusual year.

The El Niño had brought very warm water temperatures off the West Coast of the U.S. On the U.S. mainland, the normally dry southwest was being flooded, while the usually cool, damp northwest was experiencing a heat wave and drought. Eastern Canada and the northeastern United States were cooler and wetter than normal.

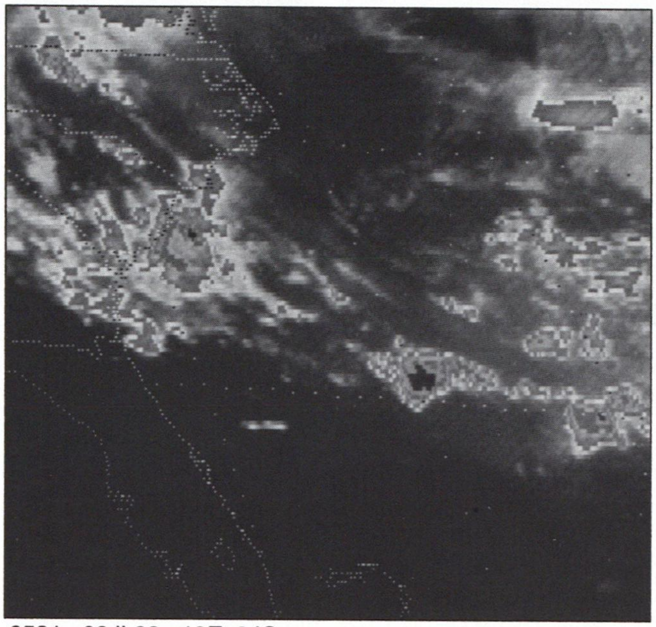
As this cold outbreak expanded in all directions, part of the cold front continued to intensify along the leading edge of the cold air which was moving toward the southwest and west along its southern boundary. The western section of the front, which threatened the Carolinas, is called a "back door cold front" because it approaches from the east rather than a normal westerly direction.

The satellite photograph at 1:31 A.M. EDT (0531 UTC) on the 3rd shows a dark gray area at the far right at about 31°N, 74°W. In this particular sensor configuration, the dark gray represents very cold temperatures and would probably only occur from the top clouds of intense thunderstorms. Four hours later a satellite photograph at 5:31 A.M. EDT shows the black area, indicating possible thunderstorms, has greatly expanded. It is now about 350 miles (560 kilometers) long and about 50 miles (80 kilometers) wide at the widest point. Now parallel to the east coast of Florida, it is moving toward the west to southwest directly at Florida.

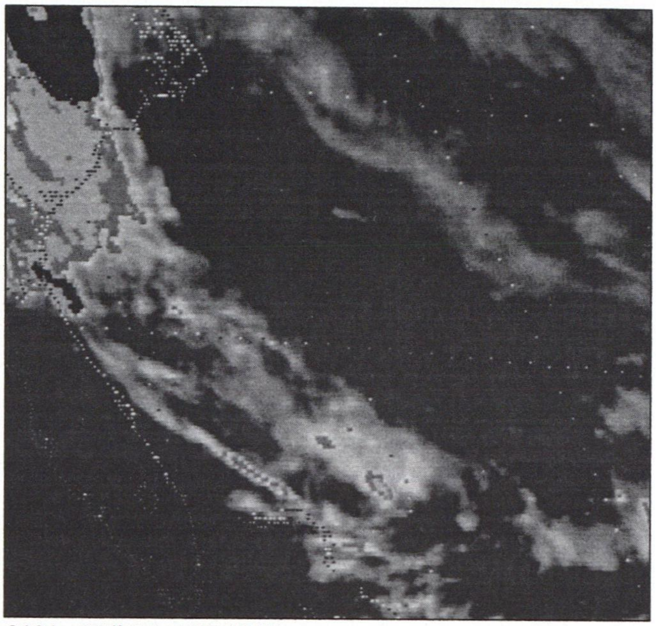
However at 9:01 P.M. EDT (1010 UTC), less than 2 hours before the waves strike, the weather system has almost dissipated. A line of clouds is about to pass over the coast. Shortly behind is an undetected wave train also approaching the coast. To the north, the interaction of the dissipating back door cold front and a trough from the west have produced some small thunderstorms east and southeast of Jacksonville. These are the thunderstorms detected on the Daytona Beach NWS radar.

At Daytona Beach on the night of July 3, 1992, the weather was postcard perfect with a few puffy clouds, a temperature around 27°C (80°F), westerly breezes at less than 10 knots with low waves and surf. To the north and east, there were occasional flashes from distant lightning which happens frequently during the summer.

Strollers along the beach and the boardwalk were horrified to see a "white wall of water 3–6 meters (10–18 feet) high" come rolling in from the ocean. It extended to the north and south as far as they could see. The time on the police report was 10:56 P.M. EDT. Along the water's edge, a police vehicle on patrol was engulfed. Its headlights provided an eerie illumination to the inside of the waves.



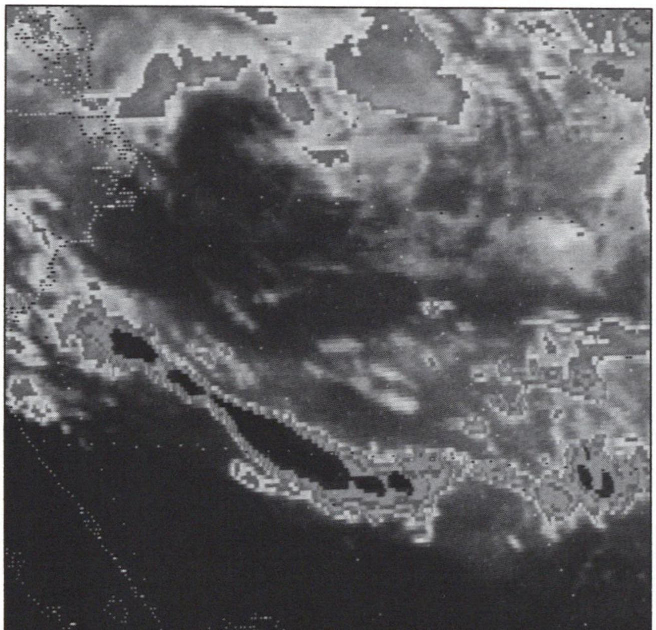
0531 03JL92 19E–2JG



0101 04JL92 19E–2MB

All of the satellite images are from infrared sensors which measure the temperature of the earth, water and clouds, including haze and fog. The satellite legend across the bottom of each photo gives the time (UTC), date and the particular settings of the sensors. For example in the photograph above, the legend indicates that the photo was made at 0531 (UTC) 03JL92. Subtract 4 from the Universal Time (UTC) for Eastern Daylight Time (EDT). 03JL92 means the 3rd of July 1992. The sensor configuration is 19E–2JG, a continuously graduated temperature gray scale (not shown). In this series the temperature decreases as the shade of gray darkens to black. There are three additional gray shade strips with white between them. The two middle gray shades allow detection of low clouds, haze and fog which is useful in describing the cold air outbreak in the north. High clouds are in very cold air and will show as black.

The photograph taken on the 3rd of July at 0531 UTC (above left) shows the cold air outflow and the development of very cold cloud tops (black) which suggest thunderstorms some 340 miles east of Jacksonville, FL. At 0931 UTC on the 3rd (below left), the very cold cloud tops continue to develop and move westward. By 0101 on the 4th (above right), the remnants of the back door cold front are approaching the Florida coast as a benign line of clouds. There is also a small thunderstorm area close to Jacksonville.

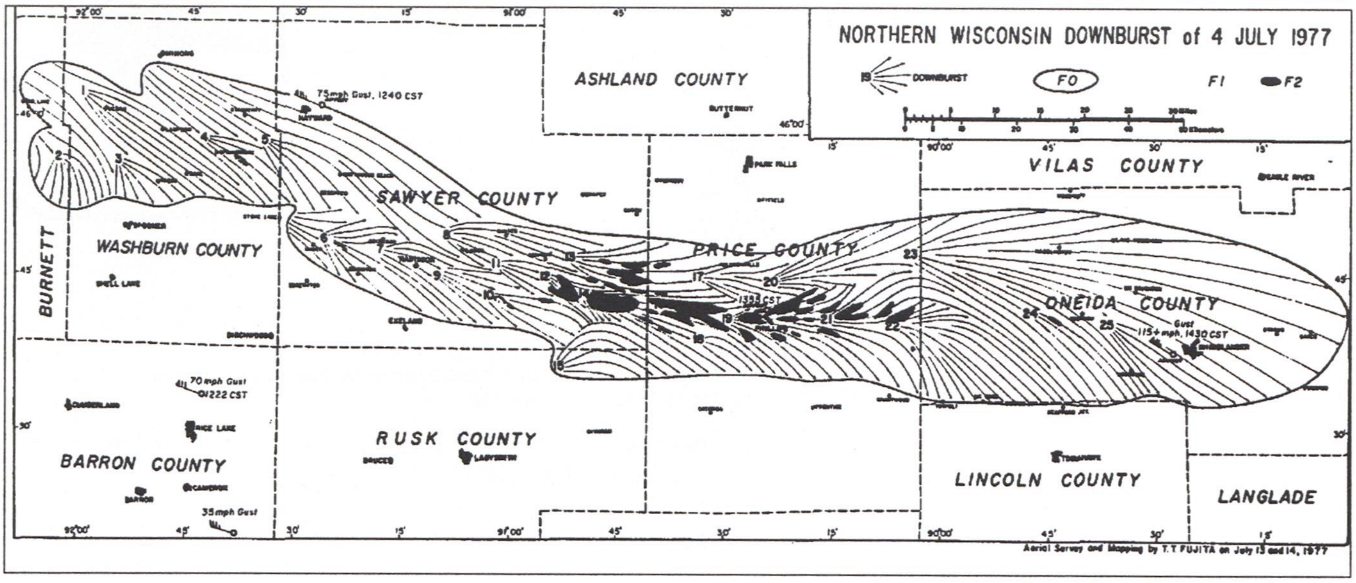


0931 03JL92 19E–2JG

The City of Daytona Beach allows vehicles to park on the broad, nearly flat, hard-packed sand of the "World's Most Famous Beach" during periods of parking overflow. Somewhere between 1,500 and 2,000 vehicles, from Volkswagen bugs to super vacation homes, were parked on the beach when the waves struck. All were floated and jammed against the seawall or under the pier. The water receded as quickly as it came. Long time residents and the newspapers couldn't recall a similar incident ever happening along the Florida east coast.

Only 100 damage reports were filed with the police, all the rest must have been filed with insurance companies. No vehicle was carried out to sea with the retreating water. Miraculously, there were no deaths and only 20 minor injuries.

High water marks were found just south of the Main Street Pier that indicated the water had reached 2.1 meters (7 feet) above sea level. At New Symrna Beach, 24 kilometers (15 miles) to the south, wave



runup was found at 1.2 meters (4 feet) above sea level. A similar runup was found at Ormond Beach, 9 kilometers (7 miles) to the north of Daytona Beach. Any evidence farther north was obliterated by rain before the investigators arrived. However, the tide gage at St. Augustine, 47 kilometers (75 miles) north of Daytona Beach, showed a short series of unusual peaks and dips at about the time the waves struck Daytona Beach. Possibly the waves extended from somewhere north of St. Augustine to as far south as Cape Canaveral.

The downburst freak wave theory is based on the work done by Professor T. T. Fujita, University of Chicago. Professor Fujita separated the damage caused by thunderstorm downbursts from that done by tornadoes. Tornadoes have a narrow track of intense damage that is left in a distinct circular pattern. Downbursts leave damage approaching the lower limits of tornado damage, but the damage may be over a broad area and is usually in a straight line or in slight curves. Any wind that blows down forests, homes and barns over land must be powerful enough to raise waves rather rapidly. The illustration above shows the damage pattern from the 25 downbursts generated by a single thunderstorm over northern Wisconsin. The major damage swath from downbursts alone was 267 kilometers (166 miles) long and 27 kilometers (17 miles) wide.

Applying this to the oceans, the wind strikes the waves at a high angle of incidence making the process of transferring energy from the wind to the water more efficient than level winds. In level flow (normal winds), the waves provide a lee area behind them so the higher the waves the less efficient the energy transfer. Waves have no lee area in downburst winds. They have been observed to be several times more effective at raising waves than level winds.

The ocean is very conservative of energy. Once energy is transferred from the wind to waves the waves persist until they dissipate by spreading, are opposed by strong winds or waves from an opposing direction or they break on a coast. As waves age they decrease in height and proportionally increase in length. When they approach shallow water with a depth one-half the wave length, the wave "feels bottom." The wave begins to slow down and increase in height as the wave length proportionally decreases. Following waves don't completely overtake the slower one in front, but by a complex process add to the group energy.

In the Daytona Beach and eastern Florida case, it seems probable that the waves broke in deeper water and the waves that came ashore were various stages of the runup, more of a surge than an overhanging wave. This scenario is based on the eye witness accounts of a white wall of water. To be white, a wave must have a large amount of air entrained in it i.e. largely made up of foam. This is supported by the minor damage to the vehicles. A cubic foot of water weighs about 28 kilograms (63 pounds). It's likely that a 3- to 6- meter (10–18 foot) wave of solid water would have caused major damage to a lot of those closely parked vehicles.

Will it happen again and when? There is no way to make a long term prediction of the reoccurrence of what would have to be classified as a most unusual event. Back door cold fronts are very rare south Cape Hatteras in the summer. This incident has been very informative. It would be difficult for a weather forecaster to forecast a situation like this without a couple ship reports from the area of development.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE

National Meteorological Center
Washington, DC 20233

January 14, 1994

Dear High Seas Marine Radiofacsimile Users,

I am pleased to announce that starting 1200 UTC, January 31, 1994, we will implement phase I of the expansion of our Pacific and Atlantic Radiofacsimile Broadcast Schedules. The schedules will contain many new and upgraded products such as full ocean coverage using a two part mercator projection of surface analyses, expanded 500 mb coverage, and additional forecasts transmitted sequentially and in a timely manner. The net result is the expansion of the Pacific radiofacsimile program from 14 to 31 charts and the Atlantic program from 8 to 27 charts (see attachment). Phase II of our expansion is expected to be implemented later this year. In this phase, storm track forecasts in the 6 to 10 day range and additional regional scale products will be broadcast.

Information concerning use and interpretation of the products is in preparation and will be distributed when available. For more information about this new National Weather Service program being conducted by the National Meteorological Center's Marine Forecast Branch please contact me (301-763-8442), the duty marine forecaster (301-763-8441) available 24 hours a day, or Glenn Paine at MITAGS (410-859-5700).

These changes could not be made without the full cooperation of the U.S. Coast Guard. It is the direct result of suggestions from Masters and Mates who attended courses at MITAGS and correspondence with users of our products. I would like to express my appreciation to all the mariners who have supported the effort to develop an improved radiofacsimile program.

David M. Feit
Chief, Marine Forecast Branch

Attachment

NOAA, NWS Atlantic Radiofacsimile Schedule

NOAA NATIONAL WEATHER SERVICE,
WWBG, RM410, WASHINGTON, D.C. 20233.
RADIOFACSIMILE SCHEDULE TRANSMITTED VIA U.S.C.G.
MARSHFIELD, MASSACHUSETTS
31 JAN 1994

TIME		CHART	TIME		CHART
1730Z		FAX HEADER	0305Z		FAX SCHEDULE
1735Z		12Z SFC ANL I	0315Z		00Z SATELLITE PIX
1748Z		12Z SFC ANL II	0325Z		00Z SFC ANL I
1835Z		FAX HEADER	0338Z		00Z SFC ANL II
1840Z		RETRANSMIT 1735Z	0351Z		00Z 500 MB
1853Z		RETRANSMIT 1748Z	0401Z		RETRANSMIT 0325Z
1906Z		12Z 500 MB	0414Z		RETRANSMIT 0338Z
1916Z		12Z SEA STATE	0700Z		FAX HEADER
1926Z		96HR 500MB VT 00Z	0705Z	R	24HR WX DEP VT 00Z
1936Z		96HR SFC VT 00Z	0715Z	R	24HR WND/WV VT 00Z
1946Z	R	GULF STREAM ANL	0725Z		48HR SFC VT 00Z
2015Z		FAX HEADER	0735Z		48HR 500MB VT 00Z
2020Z	R	24HR WX DEP VT 12Z	0745Z		48HR SEA VT 00Z
2030Z	R	24HR WND/WV VT 12Z	0905Z		FAX HEADER
2040Z		48HR SFC VT 12Z	0910Z		FAX LEGEND
2050Z		48HR 500MB VT 12Z	0920Z		REQUEST FOR COMMENTS
2100Z		48HR SEA VT 12Z	0930Z		06Z SFC ANL I
2110Z		18Z SATELLITE PIX	0943Z		06Z SFC ANL II
2120Z		18Z SFC ANL I	0956Z		06Z SATELLITE PIX
2133Z		18Z SFC ANL II	1006Z	R	GULF STREAM A
2146Z		RETRANSMIT 2120Z	1016Z	R	GULF STREAM B
2159Z		RETRANSMIT 2133Z	1026Z		RETRANSMIT 0930Z
0300Z		FAX HEADER	1039Z		RETRANSMIT 0943Z

ASSIGNED FREQ: DAY 7530 KHZ NIGHT 3242.5 KHZ

CONTRACTIONS: VT VALID TIME, SFC SURFACE, ANL ANALYSIS
WX WEATHER, DEP DEPICTION, WV WAVE, R REGIONAL N 30N/W 50W

COMMENTS: WRITE/PH 301-763-8593, PH FAX 301-763-8592

NOAA, NWS Pacific Radiofacsimile Schedule—Part 1

NOAA NATIONAL WEATHER SERVICE WASHINGTON D.C.
RADIOFACSIMILE SCHEDULE TRANSMITTED VIA U.S.C.G.
POINT REYES, CALIFORNIA (NMC) 31 JAN 94
PART ONE

TIME	AREA	CHART	TIME	AREA	CHART
0245Z		TEST PATTERN	1100Z		TEST PATTERN
0248Z	7	SATELLITE PICTURE	1104Z		SCHEDULE PART 1
0259Z	5	SATELLITE PICTURE	1115Z		SCHEDULE PART 2
0310Z	2	00Z SFC ANAL PART1	1126Z		REQ FOR COMMENTS
0323Z	3	00Z SFC ANAL PART2	1137Z		PRODUCT NOTICE BUL
0335Z	1	00Z SEA STATE ANAL	1148Z		END TRANSMISSION
0345Z	2	RETRANSMIT 0310Z	1415Z		TEST PATTERN
0358Z	3	RETRANSMIT 0323Z	1418Z	1	96HR 500MB VT 00Z
0410Z	1	00Z 500MB ANALYSIS	1428Z	1	96HR SFC VT 00Z
0420Z		END TRANSMISSION	1438Z	5	SATELLITE PICTURE
0815Z		TEST PATTERN	1449Z	9	SATELLITE PICTURE
0818Z	8	24HR WIND/WV VT 00Z	1500Z	10	12Z SST ANALYSIS
0828Z	8	24HR SIG WX VT 00Z	1510Z	2	12Z SFC ANAL PART1
0838Z	1	48HR 500MB VT 00Z	1523Z	3	12Z SFC ANAL PART2
0848Z	1	48HR SFC VT 00Z	1535Z	4	12Z TROPICAL ANAL
0858Z	1	48HR SEA VT 00Z	1545Z	2	RETRANSMIT 1510Z
0908Z	7	SATELLITE PICTURE	1558Z	3	RETRANSMIT 1523Z
0919Z	2	06Z SFC ANAL PART1	1610Z	1	12Z 500MB ANAL
0932Z	3	06Z SFC ANAL PART2	1620Z		END TRANSMISSION
0944Z	5	SATELLITE PICTURE	CONTINUED ON		
0955Z	2	RETRANSMIT 0919Z	SCHEDULE PART 2		
1008Z	3	RETRANSMIT 0932Z			
1020Z		END TRANSMISSION			

ASSIGNED FREQUENCIES (KHZ):
DAY: 8682, 12730, 17151.2, 22528.9
NIGHT: 8682, 12730, 17151.2, 4346
FOR CARRIER FREQUENCY SUBTRACT 1.9 KHZ

NOAA, NWS Pacific Radiofacsimile Schedule—Part 2

NOAA NATIONAL WEATHER SERVICE WASHINGTON D.C.
RADIOFACSIMILE SCHEDULE TRANSMITTED VIA U.S.C.G.
POINT REYES, CALIFORNIA (NMC) 31 JAN 94
PART TWO

TIME	AREA	CHART	TIME	AREA	CHART
2015Z		TEST PATTERN	2154Z	2	RETRANSMIT 2119Z
2018Z	8	24HR WIND/WV VT 12Z	2207Z	3	RETRANSMIT 2132Z
2028Z	8	24HR SIG WX VT 12Z	2219Z		END TRANSMISSION
2038Z	1	48HR 500MB VT 12Z	2300Z		TEST PATTERN
2048Z	1	48HR SFC VT 12Z	2304Z	9	SST ANALYSIS
2058Z	1	48HR SEA VT 12Z	2314Z	6	SST ANALYSIS
2108Z	5	SATELLITE PICTURE	2324Z		RETRANSMIT 1104Z
2119Z	2	18Z SFC ANAL PART1	2335Z		RETRANSMIT 1115Z
2132Z	3	18Z SFC ANAL PART2	2346Z		END TRANSMISSION
2144Z	4	18Z TROPICAL ANAL			

AREAS: 1:20N-70N, 115W-135E 6:28N-40N, EAST OF 136W
2:20N-70N, 115W-175W 7:05N-55N, EAST OF 130W
3:20N-70N, 175W-135E 8:25N-60N, EAST OF 155W
4:20S-30N, EAST OF 160W 9:30N-50N, EAST OF 132W
5:05N-55N, WEST OF 100W 10:20S-50N, EAST OF 180

CONTRACTIONS: VT=VALID TIME, SFC=SURFACE, WV=WAVE
BUL=BULLETIN, SST=SEA SURFACE TEMPERATURE
SIG WX=SIGNIFICANT WEATHER, ANAL=ANALYSIS

ASSIGNED FREQUENCIES (KHZ):
DAY: 8682, 12730, 17151.2, 22528.9
NIGHT: 8682, 12730, 17151.2, 4346
FOR CARRIER FREQUENCY SUBTRACT 1.9 KHZ

COMMENTS ON SCHEDULE OR QUALITY OF CHARTS ARE INVITED.
WRITE TO: NATIONAL WEATHER SERVICE, WWBG ROOM 410,
5200 AUTH RD., WASHINGTON, D.C. 20233 ATTN: MFB
PHONE: 301-763-8441, PHONE FAX 301-763-8592

SAN FRANCISCO, CALIFORNIA, U.S.A.

CALL SIGN	FREQUENCIES		TIMES	EMISSION	POWER
NMC	4346	kHz	NIGHT	F3C	
	8682	kHz	CONTINUOUS	F3C	
	12730	kHz	CONTINUOUS	F3C	
	17151.2	kHz	CONTINUOUS	F3C	
	22528.9	kHz	DAY	F3C	

TRANS TIME	CONTENTS OF TRANSMISSION	RPM/IOC	VALID TIME	MAP AREA
0245/1415	TEST PATTERN	120/576		
0248	SATELLITE IMAGERY (ANNOTATED)	120/576	0000	
------ /1418	96HR 500MB PROG	120/576	0000	
------ /1428	96HR SURFACE PROG	120/576	1200	
------ /1438	SATELLITE IMAGERY (ANNOTATED)	120/576	1200	
0259/1449	SATELLITE IMAGERY (ANNOTATED)	120/576	00/12	
------/1500	EAST PACIFIC SST ANAL	120/576	1200	
0310/1510	SURFACE ANAL (PART 1)	120/576	00/12	
0323/1523	SURFACE ANAL (PART 2)	120/576	00/12	
0335/-------	SEA STATE ANAL	120/576	0000	
-------/1535	TROPICAL ANAL	120/576	1200	
0345/1545	RETRANSMISSION OF 0310/1510	120/576	00/12	
0358/1558	RETRANSMISSION OF 0323/1523	120/576	00/12	
0410/1610	500MB ANAL	120/576	00/12	
0815/2015	TEST PATTERN	120/576		
0818/2018	24HR WIND/WAVE PROG	120/576	00/12	
0828/2028	24HR WEATHER DEPICTION PROG	120/576	00/12	
0838/2038	48HR 500MB PROG	120/576	00/12	
0848/2056	48HR SURFACE PROG	120/576	00/12	
0858/----	48HR SEA FORECAST	120/576	0000	
0908/2108	SATELLITE IMAGERT (ANNOTATED)	120/576	06/18	
0919/2119	SURFACE ANAL (PART 1)	120/576	06/18	
0932/2132	SURFACE ANAL (PART 2)	120/576	06/18	
0944/-------	SATELLITE IMAGERY (ANNOTATED)	120/576	0600	
-------/2144	TROPICAL ANAL	120/576	1800	
0955/2154	RETRANSMISSION OF 0919/2119	120/576	0618	
1008/2207	RETRANSMISSION OF 0932/2132	120/576	06/18	
1100/2300	TEST PATTERN	120/576		
1104/-------	FAX SCHEDULE (PART 1)	120/576		
-------/2304	SST ANAL	120/576	LATEST	
-------/2314	SST ANAL	120/576	LATEST	
1115/-------	FAX SCHEDULE (PART 2)	120/576		
-------/2324	FAX SCHEDULE (PART 1)	120/576		
1126	REQUEST FOR COMMENTS	120/576		
-------/2335	FAX SCHEDULE (PART 2)	120/576		
1137/-------	PRODUCT NOTICE BULLETIN	120/576		
1148/-------	PACIFIC MARINE ANAL	120/576		
1158/-------	PACIFIC MARINE ANAL	120/576	0900	

MAP AREAS: NOT AVAILABLE.

NOTES:
1. CARRIER FREQUENCY IS -1.9 KHZ FROM THE ASSIGNED FREQUENCY.
2. TRANSMITTERS ARE LOCATED AT THE U.S.C.G. BASE POINT REYES, CA.
3. COMMENTS AND SUGGESTIONS COMCERNING THIS BROADCAST SHOULD BE DIRECTED TO:

COMMANDING OFFICER
CG COMMSTA
BOX 560
POINT REYES, CA 94956

AND/OR

NATIONAL WEATHER SERVICE/NOAA
NATIONAL METEOROLOGICAL CENTER
WWBG ROOM 410, ATTN: MARINE
5200 AUTH ROAD
WASHINGTON, DC 20233
PHONE: (301) 763-8441

(INFORMATION DATED 01/1994)

NORFOLK, VIRGINIA, U.S.A.

CALL SIGN	FREQUENCIES		TIMES	EMISSION	POWER
NAM	3357	kHz	0000-1200	F3C	
	3820.5	kHz	ON CALL	F3C	
NAM	8080	kHz	ON CALL	F3C	
	9318	kHz	CONTINUOUS	F3C	
NAM	10865	kHz	1200-0000	F3C	
NAM	15959	kHz	ON CALL	F3C	
	18486	kHz	ON CALL	F3C	
NAM	20015	kHz	ON CALL	F3C	

TRANS TIME	CONTENTS OF TRANSMISSION	RPM/IOC	VALID TIME	MAP AREA
0000/1200	NFAX SCHEDULE	120/576		
0015/1215	SATELLITE IMAGERY	120/576	LATEST	
0030/1230	24HR 200MB PROG	120/576	12/00	
0040/1240	72HR SURFACE PROG	120/576	12/00	
0050/1250	72HR 500MB PROG	120/576	12/00	
0100/-------	72HR SURFACE PROG (NMC)	120/576	1200	
-------/1300	96HR SURFACE PROG	120/576	0000	
0110/1310	OPEN PERIOD			
0115/1315	SATELLITE IMAGERY	120/576	LATEST	
0130/-------	72HR 500MB HT PROG (NMC)	120/576	1200	
-------/1330	96HR 500MB PROG	120/576	0000	
0140/-------	96HR SURFACE PROG (NMC)	120/576	1200	
-------/1340	120HR SURFACE PROG	120/576	0000	
0150/-------	96HR 500MB PROG (NMC)	120/576	1200	
-------/1350	120HR 500MB PROG	120/576	0000	
0200/-------	120HR SURFACE PROG	120/576	1200	
-------/1400	SURFACE ANAL	120/576	0000	
0210/1410	OPEN PERIOD			
0215/1415	SATELLITE IMAGERY	120/576	LATEST	
0230/1430	OPEN PERIOD			
0240/-------	120HR 500MB PROG (NMC)	120/576	1200	
-------/1440	500MB ANAL	120/576	0000	
0250/1450	12HR SURFACE PROG	120/576	12/00	
0300/1500	12HR 500MB PROG	120/576	12/00	
0310/1510	OPEN PERIOD			
0315/1515	SST ANAL	120/576	LATEST	
0330/-------	EXTENDED SURFACE U/A PROG (NMC)	120/576	LATEST	
-------/1530	OPEN PERIOD			
0345/1545	OPEN PERIOD			
0400/1600	24HR SURFACE PROG	120/576	12/00	
0410/1610	OPEN PERIOD			
0415/1615	SATELLITE IMAGERY	120/576	LATEST	
0430/1630	24HR 500MB PROG	120/576	12/00	
0440/1640	36HR SURFACE PROG	120/576	12/00	
0450/1650	36HR 500MB PROG	120/576	12/00	
0500/1700	24HR NMG PROG (NMC)	120/576	00/12	
0510/1710	OPEN PERIOD			
0515/1715	36HR PROG BLEND	120/576	12/00	
0530/1730	12HR SIGNIFICANT WEATHER PROG (RAFC)	120/576	12/00	
0540/1740	36HR 500MB PROG W/ISOTACHS (NMC)	120/576	00/12	
0550/1750	48HR NMG PROG (NMC)	120/576	00/12	
0605/1805	OPEN PERIOD			
0615/-------	SATELLITE IMAGERY	120/576	LATEST	
-------/1815	SEA HEIGHT ANAL	120/576	1200	
0630/1830	SURFACE ANAL	120/576	00/12	
0640/1840	850MB ANAL	120/576	00/12	
0650/1850	700MB ANAL	120/576	00/12	
0700/1900	500MB ANAL	120/576	00/12	
0710/1910	OPEN PERIOD			
0715/1915	SATELLITE IMAGERY	120/576	LATEST	
0730/1930	300MB ANAL	120/576	00/12	
0740/1940	200MB ANAL	120/576	00/12	
0750/1950	24HR SURFACE PROG	120/576	00/12	
0800/2000	24HR 850MB PROG	120/576	00/12	
0810/2010	OPEN PERIOD			
0815/2015	SATELLITE IMAGERY	120/576	LATEST	
0830/2030	24HR SIGNIFICANT WEATHER PROG (NMC)	120/576	00/12	
0840/2040	36HR/48HR SIGNIFICANT WEATHER PROG (NMC)	120/576	12/00	
0850/2050	24HR 700MB PROG	120/576	00/12	
0900/2100	24HR 500MB PROG	120/576	00/12	
0910/2110	OPEN PERIOD			

NORFOLK, VIRGINIA CONT'D

0915/2115	SATELLITE IMAGERY	120/576	LATEST
0930/2130	OPEN PERIOD		
0945/-------	OPEN PERIOD		
-------/2145	84HR PROG BLEND	120/576	0000
1000/2200	HIGH SEAS/WIND WARNINGS	120/576	LATEST
1015/2215	SATELLITE IMAGERY	120/576	LATEST
1030/2230	24HR 300MB PROG	120/576	00/12
1040/2240	24HR 200MB PROG	120/576	00/12
1050/2250	48HR SURFACE PROG	120/576	00/12
1100/2300	48HR 850MB PROG	120/576	00/12
1115/2315	SATELLITE IMAGERY	120/576	LATEST
1130/2330	48HR 700MB PROG	120/576	00/12
1140/2340	48HR 500MB PROG	120/576	00/12
1150/2350	48HR 300MB PROG	120/576	00/12

ESQUIMALT, BRITISH COLUMBIA, CANADA

CALL SIGN	FREQUENCIES	TIMES	EMISSION	POWER
CKN	2752.1 kHz	CONTINUOUS	F3C	10 KW
	4266.1 kHz	CONTINUOUS	F3C	10 KW
	6454.1 kHz	CONTINUOUS	F3C	10 KW
	12751.1 kHz	CONTINUOUS	F3C	10 KW

TRANS TIME	CONTENTS OF TRANSMISSION	RPM/IOC	VALID TIME	MAP AREA
-------/1230	TEST CHART	120/576		
-------/1235	18HR SURFACE PROG	120/576	0000	A
-------/1245	30HR SURFACE PROG	120/576	1200	A
0245/-------	BROADCAST SCHEDULE	120/576		
-------/1515	TEST CHART	120/576		
0300/1520	COMBINED 850MB/500MB ANAL	120/576	00/12	C
0310/1530	SURFACE ANAL	120/576	00/12	A
0320/-------	9HR WEATHER DEPICTION PROG	120/576	1200	A
-------/2115	TEST CHART	120/576		
-------/2120	06HR SIGNIFICANT WEATHER PROG	120/576	0000	A
-------/2130	18HR SIGNIFICANT WEATHER PROG	120/576	1200	A
-------/2140	18HR SURFACE PROG	120/576	1200	A
-------/2150	30HR SURFACE PROG	120/576	0000	A
1025/-------	TEST CHART	120/576		
1030/2200	SURFACE ANAL	120/576	06/18	A
1040/2210	18HR WAVE HT PROG	120/576	00/12	A
-------/2220	30HR WAVE HT PROG	120/576	0000	A
-------/2230	SEA SURFACE TEMP ANAL (TUE & FRI)	120/576		B
	OCEAN ANAL CHART (MON & SAT)	120/576		B
-------/2240	STANDARD CHART SYMBOLS	120/576		
1050/-------	30HR WAVE HT PROG	120/576	1200	A
1100/-------	06HR WEATHER DEPICTION PROG	120/576	1800	A
1110/-------	18HR WEATHER DEPICTION PROG	120/576	0600	A

NOTES: 1. EACH TRANSMISSION PERIOD IS PRECEDED BY 2 MINUTES OF PHASE WHITE SIGNAL, THEREAFTER CHARTS FOLLOW ONE AFTER ANOTHER WITHOUT A PHASE PERIOD.

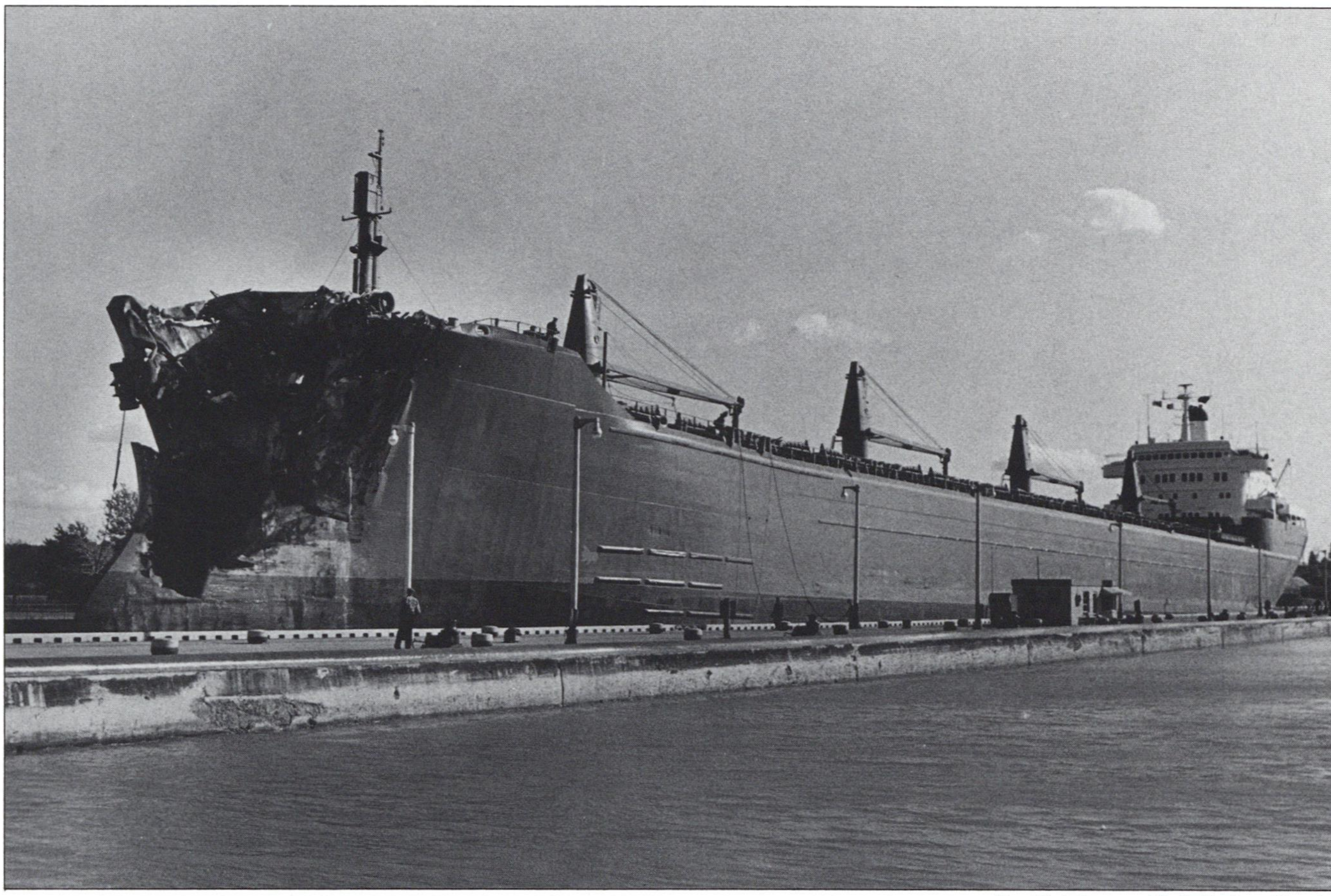
AREAS:

A -	58N	173E,	38N	160W,	36N	119W,	54N	103W
B -	46N	177W,	28N	157W,	37N	122W,	63N	121W
C -	68N	170W,	34N	160W,	27N	124W,	50N	096W

(INFORMATION DATED 11/1992)

The *Rolwi*

Skip Gillham



Bev Christiansen, *St. Catherines Standard*

The Norwegian freighter ***Rolwi*** was the first deep sea visitor to the Great Lakes to exceed 213 meters (700 feet) in length. In the late 1960s and early 1970s, ***Rolwi*** and two other sisterships ***Andwi*** and ***Nafri*** set and reset cargo records along the Seaway. When the vessel made its initial call at Duluth, Minnesota on May 5,1968, King Olav V of Norway, who was visiting the United States at the time, was among the assembled dignitaries. Later the ships were eventually eclipsed by larger carriers, but for a time this trio set the standard.

At 1920 UTC on October 2, 1973, ***Rolwi*** was gliding through thick fog upbound on Lake Michigan. Downbound came the Liberian bulk carrier ***Marathonian***. The pair had followed each other on radar, but last minute course changes brought them on the same track. By the time there had been a visual sighting, it was too late to avoid a grinding collision. Fortunately, no injuries occurred.

Both ships received massive bow damage (***Rolwi*** above) and ***Marathonian***, a rebuilt T-2 tanker, was moved gingerly to South Chicago for repairs. ***Rolwi*** went to Lorain, Ohio where temporary work allowed the ship to head overseas for permanent repairs that cost $800,000.

At last report ***Rolwi*** survives and has sailed as the ***Perozan*** since 1985. The ***Marathonian*** became the ***Sylvia L. Ossa*** in 1974 and disappeared some 140 miles west of Bermuda in a mid 1976 storm. Thirty-seven sailors went down with their ship and no distress calls were ever heard.

Joshua James—
A Most Celebrated Lifesaver

Elinor De Wire
Mystic Seaport Museum

In the old cemetery on Telegraph Hill near Point Allerton, Massachusetts is the grave of America's legendary lifesaver, Joshua James. His headstone is as simple as the epitaph on its face: *Greater Love Hath No Man Than This, That a Man Lay Down His Life For His Friends*. This cherished credo of the U.S. Lifesaving Service is especially appropriate for James.

During his lifetime Joshua James rescued 626 people and saved countless dollars in ships' cargo and gear. Sumner Kimball, his biographer and the first superintendent of the U.S. Lifesaving Service, described James as a "robust, warm-hearted, strong-handed" man who devoted his entire life to safeguarding others and who died on his feet while leading a lifeboat drill on the beach at Hull, Massachusetts.

James' father had run away to sea as a young man in Holland and ended up in Boston working as a stevedore. Eventually he married the daughter of a local shipmaster, bought his own cargo vessel, and settled in Hull, Massachusetts. Twelve children were born to the couple, the ninth being Joshua James, who arrived on a blustery November morning in 1826.

To his family James was affectionately known as "The Caretaker," for even as a little boy he was unusually selfless and showed a surprising concern for the welfare of others. His ancestry was sufficiently salty to lure him into maritime work and he showed a natural aptitude for navigation and boat handling. James spent much of his childhood helping his father haul cargoes of cobblestones for the streets of New England cities and in the process gained enormous knowledge of the coast and inshore waters. An often-repeated yarn had young James using his sensitive ears and nose to chart a safe course through the fog for a lost Boston sea captain. It was said the boy could identify, with uncanny accuracy, every inch of Boston Bay and its surrounding shores by the smells and sounds.

Exceptional abilities were commonplace in the James family. Esther Dill James, the strong and spirited mother, once rescued one of her brood from drowning in a well. With a gathering of astonished townsfolk looking on, she slithered down the slimy shaft of the well, pulled the baby into her apron, scaled back to the surface and revived the near-dead child with a 19th century version of CPR.

Mrs. James was not so fortunate some years later when the child she had rescued from the well grew to manhood and bought his own ship. While traveling on the ship with her infant daughter from Boston to Hull in 1837, a sudden squall overtook the vessel and it sank, killing all aboard. Eleven-year-old Joshua James was deeply affected by the tragedy and, as Sumner Kimball believed, set his life's course by it: "It made a great and lasting impression upon him and undoubtedly had an important influence in shaping his subsequent career as an indefatigable lifesaver."

Young James made his first rescue at age 15,

The celebrated Joshua James with the U.S. Life Saving Crew at Hull, MA, April 26, 1893. Back row, left to right: F.B. Mitchell, M. Quinn, M. Hoar, John James. Front row, from left to right: James Murphy, Captain Joshua James, Jim Dowd, George F. Pope. Photograph by Baldwin Coolidge, Courtesy of the Society for the Preservation of New England Antiquities.

assisting the volunteers of the Massachusetts Humane Society as they rowed to a wreck on Hardings Ledge. Memories of his drowned mother and infant sister roused his passion for helping others and gave him enormous strength. Though most of the records of his activities with the Massachusetts Humane Society were lost to a 1872 fire that destroyed much of the archives, the society's annual reports mention the heroic deeds of Joshua James every year from 1842 until his appointment, at age 50, to the newly-formed U.S. Lifesaving Service.

By this time James had married Louisa Lucihe and fathered 10 children, which he supported, like his father before him, with a marine freight-carrying business. The U.S. Lifesaving Service had placed four lifeboat stations in James' care at Stony Beach, Point Allerton and two points on Nantasket Beach. With the help of his large family, he divided his time between lifesaving and hauling freight and still managed an astounding number of rescues.

Among his most courageous while in charge of the lifeboat stations was the dangerous rescue of the brig ***Anita Owen***, which foundered in a December 1885 gale off Nantasket. The crew and passengers had fired a distress signal and were huddled inside the frigid aft cabin when James and his crew of surfmen arrived in the lifeboat. All 10 survivors were brought ashore in the stormy darkness and treated for hypothermia. James' journal entry for that day revealed the high drama of rescuing: "It seemed almost impossible to get alongside, as there was a heavy sea running around the stern, causing our boat to ship large quantities of water, which made it necessary for two of our men to be constantly bailing....

"Then I directed him [the captain] to lower one person at a time by a rope with instructions to drop when we were in the right position. We watched our chance and made a dash for the ship. The captain's wife was the first to swing over, but she did not let go when the signal was given, and the next instant the boat was swept out of reach. The second attempt was successful although she did not drop at the right moment and came falling between the boat and the wreck. Luckily, as she fell one of us caught her and pulled her into the boat...."

The following year James was awarded a silver medal, struck for the occasion of the 40th anniversary of his service to the Massachusetts Humane Society and his 10th anniversary with the U.S. Lifesaving Service. He was also given a gift of $50. Three years later, when Point Allerton was made a full-fledged lifesaving station, with a resident crew and spacious station house, James was appointed head keeper. At the time, the maximum age for a lifesaver was 45, but the rule was waived for James, then 62. He had proven his mettle many times, most recently in the November 1888 hurricane.

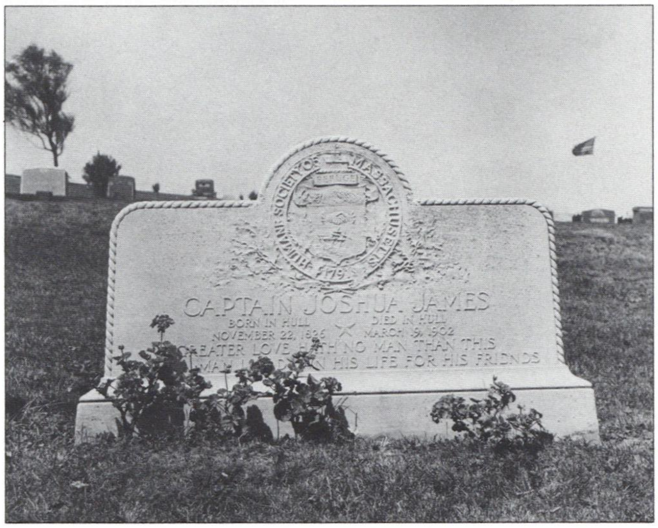
When four vessels went ashore on Nantasket Beach during that storm, James and his volunteer surfmen worked nonstop for more than 24 hours and rescued 29 people using the lifeboat and the breeches buoy. For his gallant effort, James received gold lifesaving medals from both the Massachusetts Humane Society and the U.S. Lifesaving Service. By now his collection of awards and medals was quite large. During his tenure as head keeper at Point Allerton Lifesaving Station, he attended 86 wrecks, rescued 556 people, and salvaged more than $1,203,435 in property.

Described as a "robust, warm-hearted, strong-handed" man, Captain Joshua James rescued 626 people and was decorated for many of his courageous deeds in this official photo. Courtesy of the U.S. Coast Guard. "Greater Love Hath No Man than this, That a Man Lay Down His Life for His friends," James' headstone placed by by the Massachusetts Humane Society. (photo right) marks his grave in a Hull cemetery.

Only 16 lives were lost while James was keeper at Point Allerton, and all of them in the Great Portland Gale of 1898. This infamous November 26 storm was named for the steamer ***Portland***, which went down off Cape Cod with all 129 aboard lost. At Point Allerton the storm blew in at dusk from the northeast and quickly reduced visibility to near zero. Blowing snow and sleet forced the surfmen patrolling the beach to cover their faces. It was easy to get lost in such weather, so the men depended on the tide line for guidance and were wary of the occasional surge of breakers over their path.

"The terrors and suffering which the surfmen endured as they maintained their patrols throughout that dreadful night are beyond description," wrote James in his journal. "The force of the wind was so great as to literally take away their breath, so that they were compelled to turn their backs and crouch close to earth for relief...."

Six vessels wrecked off Point Allerton Station that night. The fearless lifesavers went to the aid of two schooners and four barges, but James' sterling record was assailed by insurmountable odds. There was not sufficient time or manpower to deal with all the wrecks, and the the crews of two ships perished before the surfmen could reach them. James mourned the losses, particularly four men found frozen to death aboard the foundered ***Calvin F. Baker*** off Boston Light. Though he knew his crew had done their best, and that other New England



shores had suffered worse calamities, James was not consoled.

He had barely recovered from the Portland Gale tragedy when word of another great disaster reached him. On March 17, 1902 the entire crew of Cape Cod's Monomoy Lifesaving Station drowned trying to rescue the men of the swamped barge ***Wadena***. James, like all lifesavers, embraced the service motto: "You have to go out, but you don't have to come back," and more than anyone he knew the risks lifesavers faced. Yet this painful loss of colleagues and friends overwhelmed him.

Determined to prepare his crew for the worst possible scenario, James called the surfmen out for a rigorous drill the next morning. A northeast gale was blowing, and the sea harshly tested the surfmen's endurance at the oars of surfboat, particularly James who was now 75 years old and apt to chide any man who did not aim for the highest standards. It was a demanding workout, meant to assuage many losses. As the drill ended and the surfboat touched the beach, James leaped out onto the sand to observe the tide. A moment later, he sank to his knees. His men rushed to his side only to have him die in their arms.

The funeral was extravagant, attended by numerous dignitaries and friends, some traveling great distances to pay their respects to the hero. His casket, bedecked with flowers and nestled in a surfboat on carriage wheels, was drawn by the horses of the Point Allerton Station. While the lavish procession was meant as a tribute, it hardly was the sort of fanfare Joshua James would have liked. Had he been able to offer an opinion on the matter, doubtless he would have insisted the funeral be short and simple so his men could get back to the beach to drill and patrol.

Shooting Interiors

Michael Halminski

Nearly all my photographs are shot in locations out of doors. This affords almost unlimited choices in vantage point, perspectives and light. It's only when I shoot interiors that I find my choices to be more confined and limited to some degree. In these situations, certain lenses are apt to stay in my bag, especially the telephotos.

Most of the time, I pull out my wide angle lenses and work with them. You can take interiors with almost any kind of camera, but unless you use a wide angle lens, you may not be able to get much more than a wall or a corner.

The first thing I look at is available natural light conditions. Can I hold the camera or will I need a long exposure requiring a tripod and a cable release? Sometimes a flash or other artificial light may be necessary. Yet I try to keep things simple, so for my own work I prefer natural light conditions.

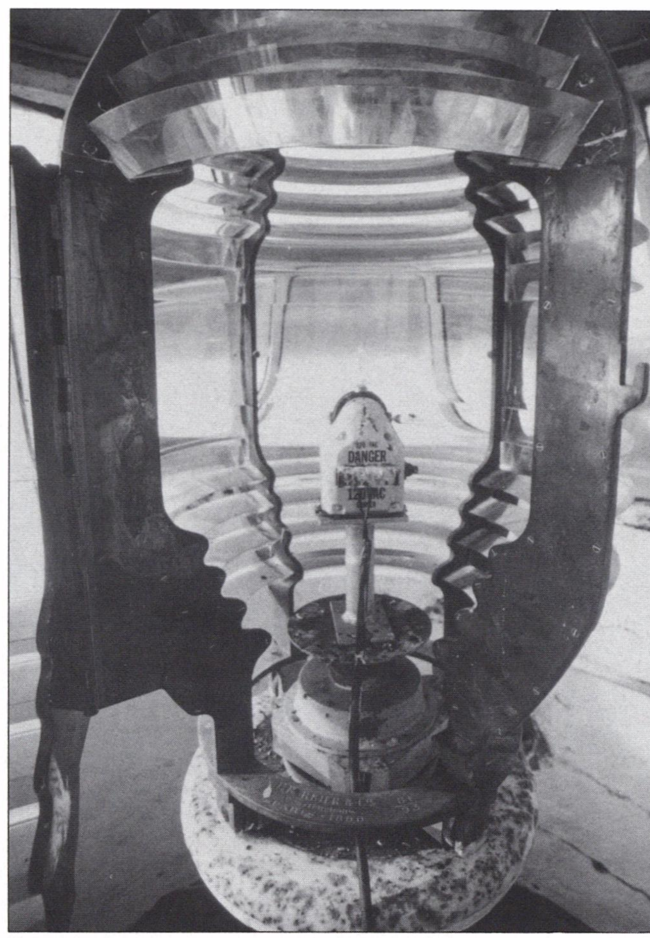
Recently, I visited some Outer Banks lighthouses to shoot their interiors. I selected six lenses ranging from 20 to 200mm. In the final analysis when I looked at my shooting session, I found that my best images were made with the 20 and 28mm lenses. The 20mm allows some distortion and covers a horizontal angle of 94°. This gives good coverage in confined interiors and if properly aimed does not distort too unfavorably. My 28mm shoots an angle of 76° which doesn't give the broad coverage of the 20 although the subject distorts much less. Again the aiming of the camera is critical to control distortion. The wider the angle of the lens, the more the distortion becomes apparent. I study the image in the viewfinder to see which way works best. I found that as I got into my 55mm lens, with a horizontal angle of 43°, that my desired full coverage was lost even though distortion was no longer a problem.

All of my interior exposure ran in the 1/8 to 2 second range, depending on the f-stop (and depth of field). This required that I use a tripod and cable release. In most cases, I bracketed my exposures which meant that I shoot what my light metering indicates and then take some additional shots, some underexposed and some overexposed. This assures that one will hit the desired exposure, and there will be options for lighter and darker shots in the final editing.

Try playing around with long time exposures in low light situations, indoors and out. There are lots of possibilities, and you might be pleasantly surprised.

The Currituck Lighthouse staircase spirals in the photo on the top of page 57. It was taken with a 20mm lens in low light. Exposure was 1 second stopped down to f11. This one required a sturdy tripod and cable release.

The photograph at the bottom right, shows the Fresnel lens assembly in Ocracoke, the Outer Banks oldest lighthouse. A 28mm lens was used and while some distortion is evident, it's not unfavorable.


DANGER

On the town with Zeggy

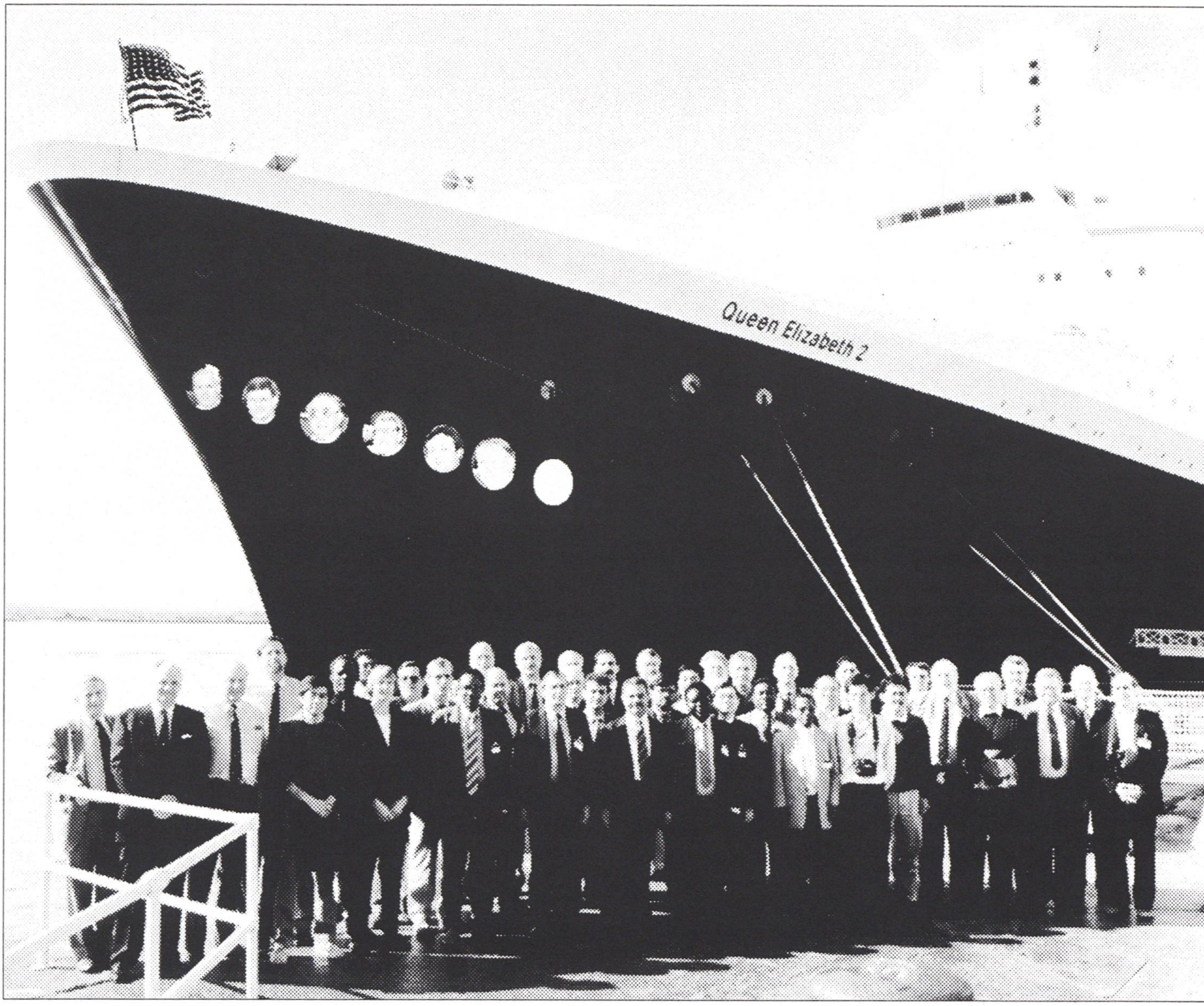
Vincent Zegowitz
Marine Observation Program Leader

Participants came from over 30 nations–representing almost as many international organizations–to attend the first International Port Meteorological Officers Seminar and Workshop which met September 20–24, 1993, in London, England. Meetings were held in the headquarters of the International Maritime Organizations (IMO) with the goal to formulate specific recommendations for the improvement and expansion of PMO services and the Voluntary Observing Ship (VOS) program.

Some interesting topics were discussed:

- increased efforts to recruit deep ocean vessels as VOS reporters,
- the importance of ships' officers understanding the need for weather observations from ALL areas of the oceans and not just those waters of national interest,
- the need for training courses on the use of INMARSAT equipment, including the transmission of meteorological reports,
- the importance of the PMO in helping ships officers with meteorological/oceanographic observations as well as interpretation of weather forecast products,
- the improvement of observing techniques and equipment availability,
- quality control monitoring of marine weather observations to improve the data,
- solicitation of response from marine users concerning the value and applicability of forecasts and marine products,
- the need for better coverage throughout the worlds oceans, and

On the River Thames with PMO Jim Nelson. It's incredible, but he was actually behind the camera. It is a beautiful photograph and the view shows Westminister Abbey, the Houses of Parliament, and Big Ben.



The International PMO group photograph was taken in front of the QEII. The attendees that were there thought the American delegation had opted to go out on the town. However as the photograph indicates, they managed to get aboard the vessel and even establish a claim of sorts (see flag). The one empty porthole was where the editor or even the associate editor of the Mariners Weather Log would have been had the Americans thought they were important enough to invite.

■ The appreciation and value of each ship meteorological observation submitted by the shipboard observer.

The meeting resulted in a firm set of recommendations to national meteorological services and the World Meteorological Organization (WMO). Usually things on an international scale work slowly and we have to work at the speed and technological capability of countries not fortunate enough to have all our gizmos. Everyone recognized the importance of better forecasting, coverage and improved reporting, but sometimes these items understandably must have lower priority to pressing social or governmental concerns.

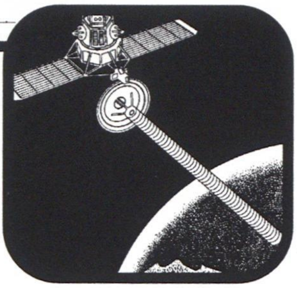
Currently, we are all being asked to do more with less and the PMO/VOS programs are no exception. Still, our programs can improve and we must try to move in that direction. The primary objective of the whole marine observations program is to provide better forecasts for the mariner. Remember only you know what the weather is like at your location... REPORT IT.

Suggestions you may have to improve the programs are always welcome. Send them to me c/o National Weather Service, NOAA, 1326 East-West Highway, Rm 17312, Silver Spring, MD 20910.

Canadian Port Meteorological Officers Workshop meets in Burlington, Ontario. Front row: Lone Murton (PMO Western Region), Rick Shukster (PMO Ontario Region), Terry Mulane (Ice Centre Ottawa), Denis Blanchard (PMO Montreal), Candi Zell (AES Headquarters), Vince Zegowitz (NWS Washington), Ron Fordyce (PMO Ontario Region), Pat Walton (MWO DMetoc Halifax). Second row: Vaughn Williams (PMO Pacific Region), Keith Clifford (PMO Ontario Region), Doug Henry (PMO Central Region), Roland Kleer (AES Headquarters), Ken Horne (Health and Safety Officer – Ontario Region), Nancy Stadler–Salt (Ontario Weather Centre), Jack Mann (National Health and Safety Officer AES Headquarters), Charles Anderson (Canadian Meteorological Centre Dorval) Bob Struthers (Customs Ottawa), Erich Gola (PMO Montreal), Doug Longmire (Customs Ottawa), Lloyd Barnaby (AES Headquarters), Rod Prior (AES Headquarters), Joe Shaykewich (AES Headquarters).

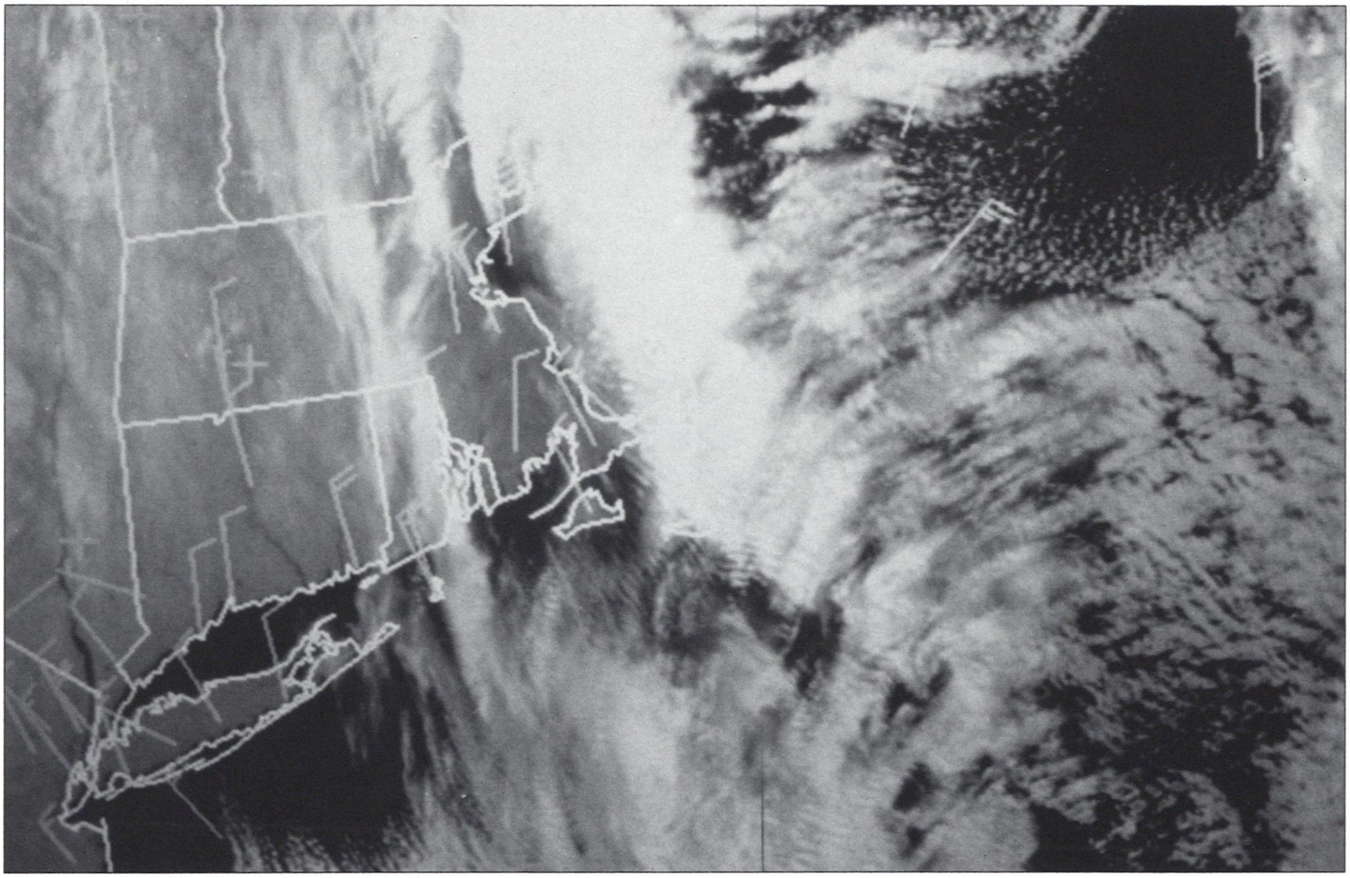
The Ontario Region was host to the Canadian Port Meteorological Officers Workshop which was held at the Canada Center for Inland Waters (CCIW) Burlington in late August. The workshop was held in an effort to strengthen the relationships between marine programs. Representative came from the Canadian Regions, AES Headquarters, the military, other government departments and representatives from the United States. The 5-day workshop focused on PMO activities, the Canadian Buoy Program, shipboard safety and safety at sea training. Workshop objectiveswere twofold–first, to discuss Canadian VOS and buoy programs and make specific recommendations for the improvement and efficiency of these programs. Second, changes occurring within this organization increase the need to inform all people involved in the Canadian Marine Program of current situations throughout the respective regions.

In photo at left, Amerada Hess Corporation receives Recogniton Award from the National Oceans SEAS Program. William Woodward, Ocean Obserations Branch of the National Ocean Service, (far left) presents an award to Kevin J. Mannion, Marine Operation Supervisor and (right) Raymond W. Marquardt, Port Captain of the Amerada Hess Corporation, New York, New York. Photographer (not shown) is Steven K. Cook, who carried bags for Mr. Woodward on his trip to New York.



Cape Cod Snowstorm

Mark Ruminski
NESDIS



The satellite image above is from the NOAA 11 spacecraft and was captured at 0829 UTC on February 19, 1993. The area depicted is the northeastern U. S. centered over Cape Cod.

At first glance the imagery appears to depict a fairly innocuous cloud system stretching from southern Maine to the eastern Cape. However, a raging snowstorm was occurring along the western edge of the cloud band. Total snowfall from the storm reached 18 inches at Chatham, Massachusetts on the southeast tip of the Cape, 24 inches at Provincetown on the northern tip and 20 inches at Wellfleet in between. Most of this fell in about a 6-hour period starting shortly after the time of the satellite photograph. Snowfall dropped off rapidly at points to the west, with 6 inches reported at Hyannis and only 2 inches at Boston.

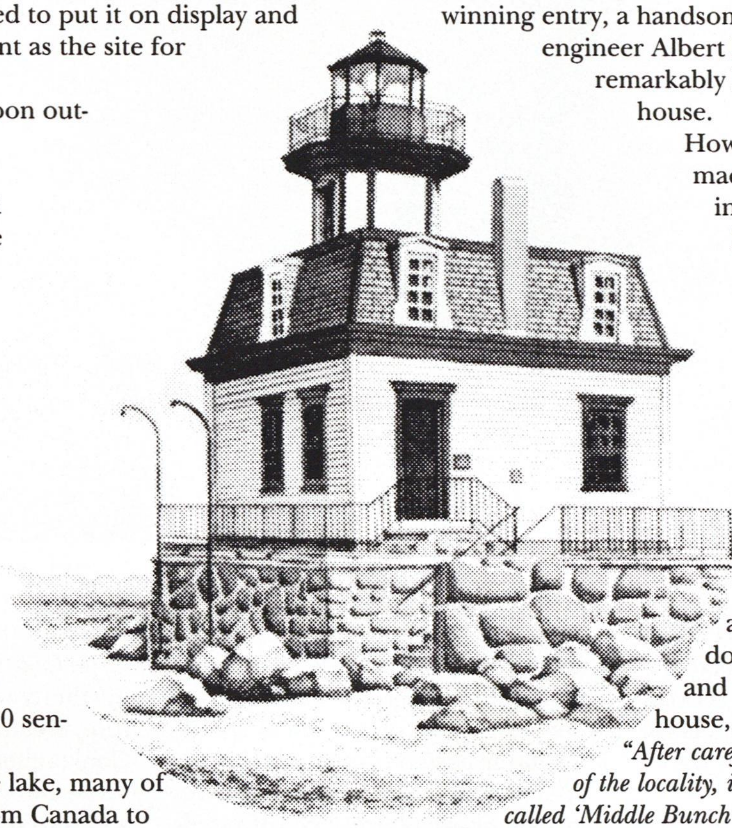
The snowstorm had elements similar to lake effect snow squalls common to the lee of the Great Lakes. Cold continental air passes over relatively warmer waters of the Atlantic Ocean and Cape Cod Bay, as seen by the northerly winds plotted on the picture, creating an unstable air mass. Converging low level winds act to focus and release this instability in a localized area. The converging winds are represented by the two ship reports in the open Atlantic east of Boston, with northeast winds of 25 knots converging with northerly winds over land.

Colchester Reef Lighthouse

Elinor De Wire
Mystic Seaport Museum

At the turn of the century, heiress Electa Havemeyer Webb began collecting antiques, beginning with a cigar store Indian in 1906. As her passion for Americana swelled, so did her collection. By World War II, she decided to put it on display and chose Shelburne, Vermont as the site for her museum.

The collection soon outgrew its single-building, 8-acre home when Mrs. Webb became enamored of American architecture and began collecting historic buildings and structures. One of the earliest of her large-scale collectibles was the Colchester Reef Lighthouse, retired to the Shelburne Museum in 1952 after a long and eventful career as a navigational aid on Lake Champlain.



Colchester Reef Light was one of about 10 sentinels to serve the steamers of the lake, many of them hauling lumber from Canada to Burlington and Albany. It sat on a stone foundation surrounded by water and warned of a group of dangerous reefs off the tip of Grand Isle, which jutted southward into the middle of Lake Champlain.

According to author Gordon P. Manning, the design for the Colchester Reef Lighthouse was obtained through a contest held by the Lighthouse Service in 1869. The contest was meant to interest notable architects and engineers in the business of lighthouse building. The present exhibits in the Colchester Reef Lighthouse include the presumed winning entry, a handsome design by Burlington engineer Albert R. Dow that looks remarkably like the actual lighthouse.

However, no mention is made of such a competition in the reports of the Lighthouse Board during those years, nor was it likely the parsimonious and business-like government organization would conduct such an activity. It's likely the "contest" was more fable than fact, and Dow probably negotiated a contract for the design. The annual report for 1871 does detail the placement and blueprints for the lighthouse, as well as its cost:

"After careful examination and survey of the locality, it was found that the rock called 'Middle Bunch' was the proper place for the new Light-house. This rock is in the middle of the channel, with seven feet of water over it at low water, and deep water on either side. With a Light thereon a vessel can pass on either side close to the rock...."

The crib for the light's foundation was made in Burlington, towed to the site, sunk, and filled with concrete and stones. Two courses of the foundation stonework were laid before the work season ended in 1870, just high enough to bring the structure above water. The following spring, ice jams tore away some of the stonework as if to hint of challenges ahead.

The lighthouse was completed and lit in December 1871, exhibiting a fixed white beacon visible for 11 miles. Kerosene oil lamps were used with a Fresnel lens, probably fourth order. There was also a fogbell, operated by an automatic bell striker, that sounded once every 20 seconds in periods of poor visibility. The crank for winding up the striker's weights was conveniently located inside the house.

Herman Malaney was the first keeper, with Walter M. Button as his assistant. When Malaney retired in 1882, Button became the head keeper. The government decided that an assistant was no longer needed, especially since Button had a wife to live on the light with him and to help with the work. Harriet Button turned out to be a steadfast assistant, but she soon learned that the lake ruled her life.

Colchester Reef was the only lighthouse on Lake Champlain to be built on a crib structure which was set on a rock some 7 feet below the surface at low water. The original cost was $20,000 but another $10,000 was needed within 2 years for repairs and strengthening. Sketch by Paul Bradley, Jr.

That fact became miserably apparent in 1888 when the couple's fifth child was born. They had arranged to signal a friend ashore when the doctor was needed. A thin sheet of ice covered the lake the January evening that the signal was sent. When their friend and the doctor were about halfway to the lighthouse, a wind came up and the ice began to crack. The two watched as a fissure opened between them and the lighthouse, and the floe they were occupying began to move northward, away from their destination.

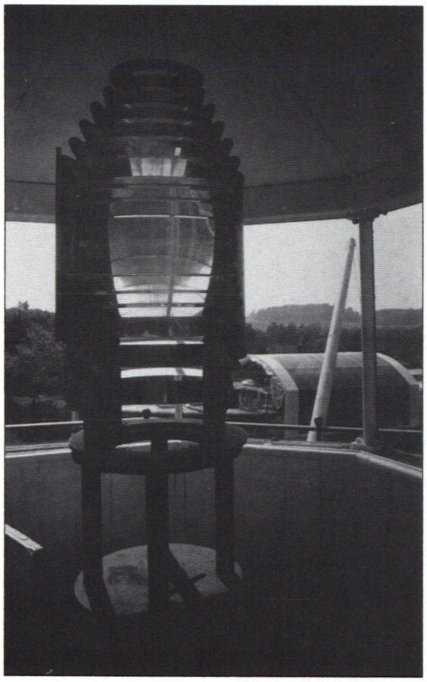
Walter Button, standing at a window in the lighthouse, watched in horror as the men hopped from one cake of ice to another then disappeared in the darkness to the north. A short time later his new daughter arrived hale and hardy while happily for the Buttons' friend and the doctor, they drifted in the darkness for several hours before they were able to wade ashore and hail a ride home.

The six Button children found ways to entertain themselves on the cloister. The lighthouse had a 4-foot wide walkway around it, and the reef was above water on two sides of the stonework foundation, so the youngsters did have a small playground of sorts. They were permitted to take the boat to a nearby island where the family kept a garden. And there was always an assortment of pets at the lighthouse, including two squirrels who mysteriously appeared one winter day, were caught and eventually persuaded to remain as house pets.

Walter Button retired in 1901 and handed the lighthouse keys to his son, Chester, who served 8 years. Though shipwrecks were not common on Lake Champlain, one is recorded in the younger Button's logbook. On a June evening in 1905, the 27-ton passenger steamer ***Mariqui,*** returning to Burlington from Plattsburg, hit Colchester Reef in spite of the fact that the night was clear and the lighthouse was brightly lit. A celebration might have been underway on board the steamer since its passenger list included the Burlington baseball team and their fans. Perhaps the skipper also caught up in the revelry forgot to watch out for Colchester Reef.

Using a rowboat, Chester Button managed to rescue all the passengers and to afterwards refloat the boat.

The sentinel's most devoted lightkeeper was a burly German immigrant named August Lorenz. He spent 22 years alone on the light and as penurious as the service that employed him. Lorenz' guests often groused that he boasted about his bankroll while serving



Elinor De Wire

The original lighthouse lens was damaged by a storm in 1873. It was replaced by a sixth order lens with a fixed red light.

them beans and bread. Lighthouse keepers were poorly paid, but Lorenz managed to save $28,000 during his career, cleverly deposited in three different banks so that no one would know his total worth.

Many of Colchester Reef's lightkeepers went ashore in the winter when navigation shut down on the frozen lake, but not Lorenz. The lighthouse was the center of his life, and he refused to leave it even when chunks of ice ground against it and the winter wind came howling down the lake. Most winters the lake froze over entirely so that ice fishermen could set up camp near the lighthouse and adventurous shore residents could visit the keeper in horse-drawn sleighs.

Having watched many unfortunate souls fall through the ice and then having the job of pulling them out both alive and drowned, Lorenz determined that such a fate would never befall him. Whenever he ventured out on the frozen lake he carried a long, spiked pole that he could use to snag the ice and pull himself out in the event he crashed through the surface. Fortunately, he never needed it for this purpose, but it did come in handy on another occasion. One spring the lake had begun to break up and clog in places with huge cakes of ice. On this particular day a brisk southwest wind pushed the floe around the lighthouse. During the day Lorenz kept watch over the ice floe to see that it moved along without too much interference, but throughout the dark evening hours he could only listen to the grinding and rending of ice along the sides of the lighthouse's stone base. He was worried that the ice would pile up against the stones on a windy night and push the lighthouse off its foundation.

That evening, it almost happened. Lorenz was in the lantern working when a terrible crash and screech of wood splintering sent him rushing down the stairs. As he entered the lighthouse kitchen, oil lamp in hand, the southwest corner of the room split open, and huge pieces of ice pushed through. Lorenz danced about the kitchen in fright, avoiding the small frozen chunks that scuttled across the floor. After a minute or two, the wind reversed and the monstrous intrusion of ice slid back out, leaving a gaping hole in the kitchen wall.

Residents ashore grew uneasy at the sounds coming from the lake that night–the ice gnawing at the lighthouse foundation–and they worried for August Lorenz's safety. Imagine their relief the next morning when the familiar profile of the keeper was seen at the railing of the lighthouse deck.

Later in the day he was gingerly leaping about on the ice surrounding the lighthouse. His dory, ripped from its davits and carried away during the night, was sitting up-side-down on a floating cake of ice not far from the lighthouse. He was determined to rescue it, since he had saved his own money to buy it, and he wasn't about to let the lake have it. The wind was slowly moving the little ice cake toward him, and at the right moment he reached out with the long pole–the one he always carried while on the ice–and snagged the vagabond vessel.

Lorenz retired in 1931, not by choice but because the Lighthouse Service decided he was too old to remain on duty. The lighthouse was briefly tended by Joseph Aubin, then decommissioned in 1933 after an automatic flashing beacon replaced it. Shuttered and locked, it sat dark for 20 years before the Coast Guard put it up for sale.

At about the same time, Heiress Electra Havemeyer Webb thought a lighthouse would be the perfect companion for the sidewheeler ***Ticonderoga***, which she had just purchased and given a new home in the grass at Shelburne Museum.

Colchester Reef Lighthouse was carefully dismantled and removed from its stone foundation, then transported to the museum piece by piece. There it was reassembled on a replica of the stone base. Huge rocks were piled around it as if it were still vulnerable to those punishing chunks of lake ice. The interior was refurbished and opened as a gallery of marine art.

Later, some lighthouse artifacts were acquired and put on display, among them a melodious old fogbell like the one that long ago bonged across Lake Champlain when the air was thick.

The *Lee A. Tregurtha*

Ken Remington
National Weather Service, Buffalo

As a NWS Forecaster, I knew a voyage on the ss ***Lee A. Tregurtha***, a freighter of the Interlake Steamship Company, would provide firsthand experience in wind and wave forecasting– how observations are taken and sent, how lake freighters use the forecasts and if changes in our products are needed.

On the October 5th, 1992, escorted by PMO George Smith, I boarded the vessel near Toledo and was greeted by 1st Mate Joe Ruch and introduced to the boat's captain, Timothy Dayton. After we took on a load of coal, we'd travel north through Lake St. Clair, up the St. Clair River across Lake Huron to Sault Ste Marie by way of the St. Mary's River. From there we would traverse the Soo Locks and sail through Whitefish Bay and Lake Superior to Ashland, Wisconsin where we would unload the coal. Finally, we would take on a load of iron ore pellets for transfer to Ford Motor Company's Baton Rouge plant, south of Detroit.

By 0545 (except when noted all times local daylight), the ***Lee A. Tregurtha*** was moving into Lake Erie. A few stratocumulus clouds appeared in front of the rising sun with a northwest wind around 13 knots; waves were less than 1 meter. At 1025 we entered the Detroit River and passed under the Ambassador Bridge linking Detroit and Windsor, Ontario. Winds were light and variable and only a few clouds appeared in the sky.

Meanwhile, Captain Dayton was studying the charts he'd requested: a fax copy of the 0700 surface chart for October 6 from the National Weather Service Office in Cleveland, a Great Lakes 2000 UTC surface prognostic chart issued by Environment Canada's Toronto office, mafors issued for each of the Great Lakes by the U.S. National Weather Service Offices and the Canadian plain language forecasts issued by the Toronto office for all of the Great Lakes.

As we sailed north up the St. Clair River, I pointed out a beautiful sundog as we passed under the Blue Water Bridge connecting Pt. Huron, Michigan with Sarnia. Later I noted the weather conditions about 40 kilometers (25 miles) offshore of Harbor Beach on Michigan's "thumb.": partly cloudy, wind from the northwest at about 9 knots and waves less than 1 meter.

The 7th dawned mostly cloudy and the winds were variable from the northwest to northeast at 6 knots. The waves on the northern end of Lake Huron were less than 1 meter. We went through Potagannissing Bay, Munuscong Lake, and Lake Nicolet, then entered the St. Mary's River. At times the channel was only about 60 meters (200 feet) across. It seemed as though the walls of the summer cottages that stretched along each side could be touched. The weather was partly to mostly cloudy from DeTour Village to Sault Ste. Marie, and there was an extensive cloud bank to the northwest associated with a stationary front which extended from near Sault Ste. Marie southwest to Iowa.

Winds were northeast at 10 to 15 knots west of the front over the center of Lake Superior and generally south at 5 to 15 knots east of it, where we were now travelling. Marine observations from Lake Superior at this time indicated that waves were averaging about 1 meter (3 feet) near the Keweenaw Peninsula (just west of the front) and less in the northern portion of Lake Huron, behind us.

When the ***Lee*** received permission to enter the Soo Locks at 1345, the captain positioned the boat inside at 1400. It took 15 minutes to raise the water level the 6 meters (20 feet) necessary to get the boat up to the same height as

The steamship ss ***Lee A. Tregurtha,*** *has a long and distinguished hitory on the Great Lakes. The ship is a product of 4 shipyards. The bow and stern were built in Baltimore 1942, the mid–body was built in Hamburg, Germany in 1960. In Lorain, Ohio, it was reconstructed and coverted in 1961 and then lengthened to its current 826 feet in 1976 .*

Lake Superior. We entered the eastern end of Lake Superior at 1745, just as the sun was about to set behind the clouds associated with the front.

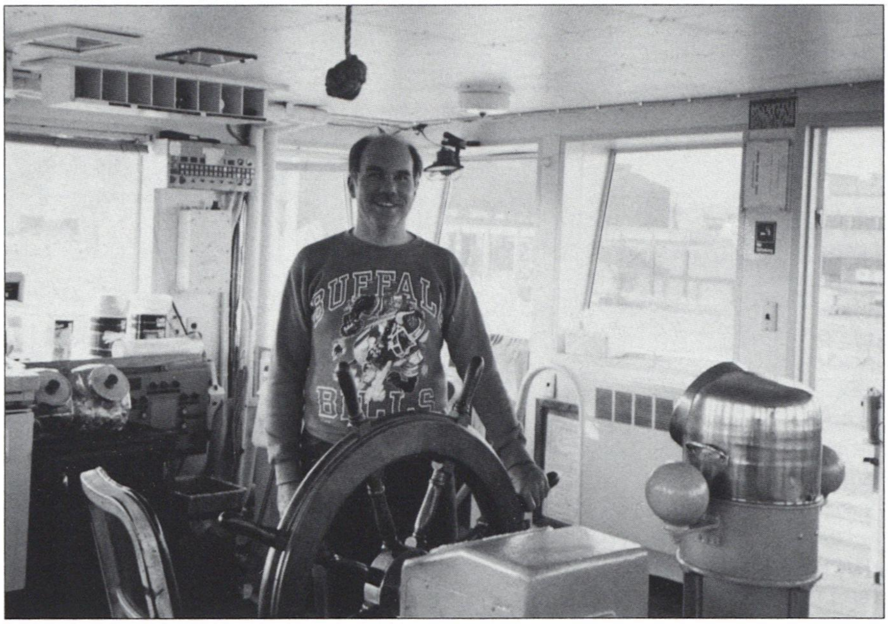
By Thursday morning, we had crossed the front and passed the northern tip of the Keweenaw Peninsula of Michigan near Eagle Harbor. Our marine weather at 1000 indicated: northeast winds at 10 to 20 knots, 1.5- to 2- meter (5 to 6 feet) wave heights approaching the aft starboard flank, cloudy skies, air temperature of 7°C (44°F), and lake temperature was approaching 10°C. Four observations were taken, two on October 7th on our overnight trip north through Lake Huron, and two early on the 8th from the eastern end of Lake Superior. The observations were logged on the Weather Service B–81 and radioed to WLC, a marine telephone based in Rogers City, Michigan. They would be disseminated to the National Weather Services Offices in the Great Lakes area, Coast Guard stations, all of the boats on the lakes, and other users.

Moving southwest along the Michigan shoreline, we passed Madeline Island, Wisconsin (Apostle Islands) in the early afternoon. The winds increased out of the northeast to 25 knots with a few higher gusts.

The harbor at Ashland, Wisconsin opens up to the northeast, and the waves funneling into the harbor had built to about 1.5 meters. Unloading the coal at the C.L. Reiss coal dock took about 6 hours. The rain finally caught up to us and the barometric pressure had dropped somewhat since the 1000 reading had been taken. The center of the low was just southwest of us which accounted for the gusty northeast winds. If the wind remained strong and the waves high, we woudn't be to leave the dock on schedule. Before we could leave the harbor, the boat had to be backed out from the dock and swung around 180°. However, by 0045 the winds had slackened to 13 knots, and the waves subsided. The captain filled a few ballast tanks with lake water so that the boat would ride slightly lower in the water. As we meandered through the Apostle Islands during the next 2 or 3 hours, Dayton expected to encounter the type of winds and waves we had experienced the day before. However, it began to rain again and the winds increased to 30 knots from the northeast so Dayton determined it would be better to deviate from his planned course and kept to the lee of Devils Island. Just before we reached it, the winds hit 35 knots from the northeast and when we came out from behind the island swells were 2 meters (7 ft).

It was raining as we entered Duluth Harbor on the 9th to pick up a load of iron ore pellets. The barometer showed the lowest reading of the trip at 999 millibars. Winds were northeast at 13 knots, and the waves were less than ½ meter.

That evening Captain Dayton and I talked about the adequacy of Great Lakes marine forecasts. I explained that my office forecasts for the nearshore and open water conditions of Lake Ontario and the nearshore of Lake Erie while the Chicago office covers Lake Superior and Lake Michigan. Ann Arbor



*Ken Remington on the bridge of the **Lee A. Tregurtha** proudly displays his Buffalo Bills sweatshirt, or maybe he was just seeking sympathy.*

produces the forecasts for Lake Huron and Cleveland is responsible for the open waters of Lake Erie. I explained that a good part of the problem of inadequate forecasts is due to the lack of observations on the lakes. When the forecaster doesn't know the weather in the center of the lake, it makes forecasting very difficult. Gale warnings for example are issued 24 hours before the gales are expected on a particular lake. Once the National Weather Service has completed its modernization program, the lakes should be more effectively covered.

The captain stressed a preference for two directions within the worded forecast for the open lakes, i.e., northwest to north winds although a single direction is sufficient in the mafor. Moreover, the two direction worded forecast provides a window for the mariner. Dayton gave a recent example. Marquette has a shoreline which runs from the southwest to northeast along Lake Superior. Dayton said if the wind direction was southwest or west, a boat can easily enter or leave Marquette Harbor. However, if the winds are from the northwest, a captain may elect to remain in port. If the boat does leave, it would remain close to the shoreline for awhile instead of heading for the open water of the lake. So if the forecast reads "west" winds, but there may be a chance of winds from the northwest, the captain would not be presented with the option of remaining at the dock. If northwest winds predominated and the boat had left the protection of the harbor, there would be a problem with waves once the boat hit the open water.

By the morning of the 10th, we had crossed about half of Lake Superior. The latest Great Lakes worded forecasts and mafors came over the teletype at 1000 LSAT. The mafor called for the winds to increase to force 4 (the captain's terminology) or 30 knots from the northwest, and the waves were expected to build from 1 meter (1 to 3 feet) in the morning to 2 meters (4 to 6 feet) in the afternoon. There was no evidence of conditions deteriorating.

By late afternoon, the winds were northwest but only 15 knots and the waves were around ½ meter.

We passed Whitefish Point lighthouse (and officially left the open waters of Lake Superior) at 1815. Some haze had formed and the wind was still very light from the southeast when we reached Grosse Pointe Light at the southern end of Whitefish Bay.

Sunrise on Sunday the 11th saw us in Lake Huron about 80 kilometers (50 miles) due east of the Straits of Mackinac. Around noon, showers and drizzle were reported at Flint and Port Huron, Michigan. During the afternoon, northwest winds increased to 10 to 20 knots and waves built to 1 meter by evening. As we approached Port Huron, there were a few showers and I noticed a slight funneling of the water as the water from the lake was constricted as it tried to enter the St. Clair River. The 1st Mate, Ken Michels, commented about the "undertow" here. He said that with a northwest wind, the boat tended to drift to port (left) downbound. We passed downtown Detroit at 0100 and arrived at the Ford Motor Company dock at 0425. The weather was clear and the air temperature was 6°C (43°F) as my voyable aboard the ss ***Lee A. Tregurtha*** ended

This voyage provided me with many opportunities to gain insight into the normal operation of a typical Great Lakes freighter. I am very appreciative of the hospitality of the captain and crew of the ss ***Lee A. Tregurtha.***

Estimating Hurricane Waves

Professor S.A. Hsu
Louisiana State University

In my article on forecasting hurricane waves in the Spring 1991 issue of the ***Log,*** I proposed a simple formula to estimate the significant wave height H_s, under hurricane conditions. H_s represents the average height of the highest one-third of the waves observed at a specific point. H_s is a useful parameter because it is approximately equal to the wave height that a trained observer would visually estimate for a given sea state. Note that the left-hand side of Eq (2) in Hsu (1991) should be corrected as $(g^T{}_m)/U_{10}$. The equation proposed in Hsu is

(1) H_s (in meters) = 0.20 (1013–P_0)

or

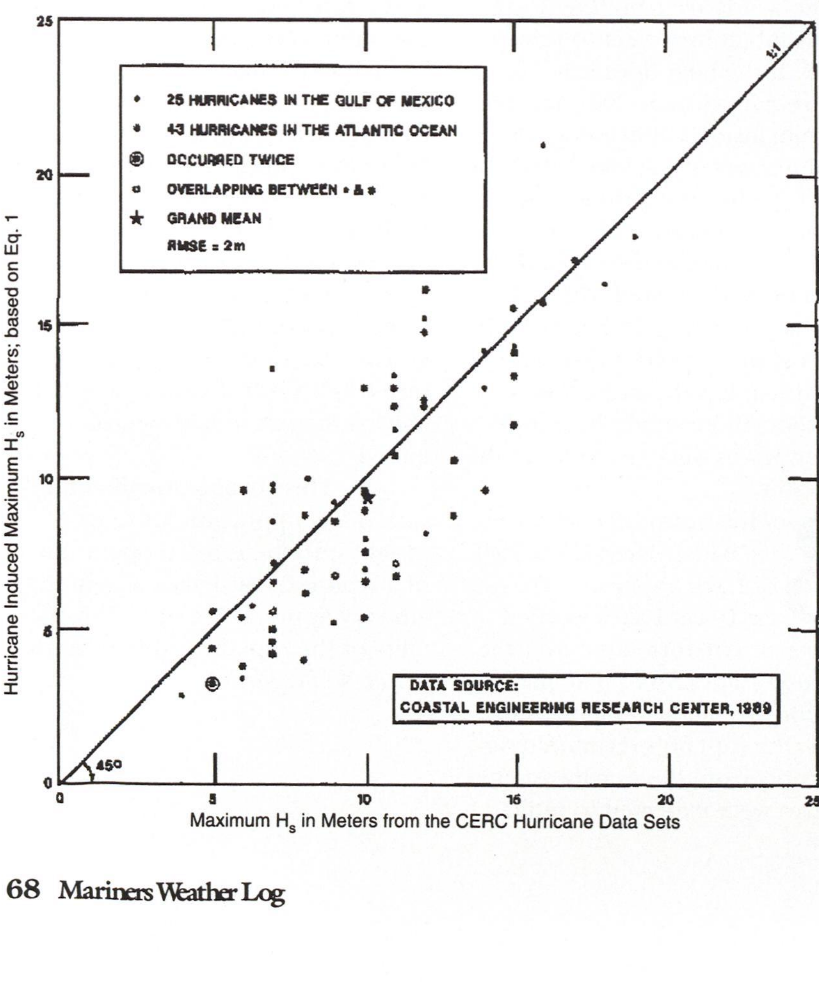
(2) H_s (in feet) = 0.66 (1013–P_0)

where P_0 is the sea-level pressure in millibars at the storm center. The pressure value of 1013 represents conditions near the outer edges of the hurricane.

This note further verifies Eq. (1) by employing 68 hurricane datasets containing P_0 and H_s. In this case H_s is the maximum H_s under the minimum P_0 conditions. The datasets were obtained from the Coastal Engineering Research Center (CERC) (1989). In this report, 25 and 43 hurricanes from the Gulf of Mexico and the Atlantic Ocean, respectively, were studied.

The chart below shows the results of our comparison between Eq. (1) and the dataset from CERC (1989). Since the value of the root-mean-square error (RMSE) (see, e.g. Panofsky and Brier, 1968, p. 201) is 2 m when H_s ranges from approximately 5 to 20 m, Eq. (1) may be considered to be verified. Furthermore, since the mean H_s of the CERC datasets is 10.1 m and that of Eq. (1) is 9.4 m, these two mean values are in agreement within 93% as shown by the large star for the grand mean in the chart. It should be noted that the H_s data provided in CERC are in whole meters.

On the basis of the above analyses it is concluded that Eq. (1) is verified for operational applications for quick estimates of H_s from P_0.



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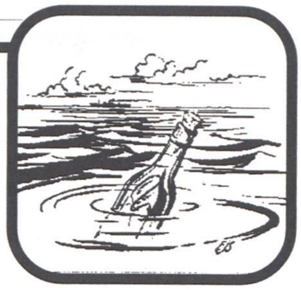
Panofsky, H.A. and G.W. Brier. Some Applications of Statistics to Meteorology, Pennsylvania State University, University Park, PA, 1968.



Data Acquisition—A Crucial Component

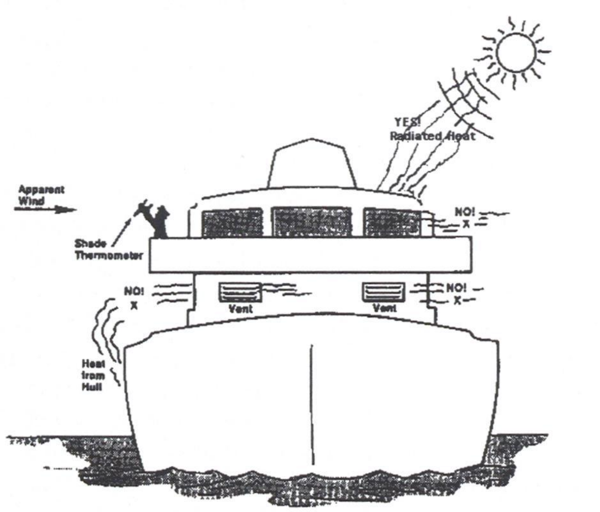
Martin S. Baron
National Weather Service,

The collection of data is vital to the science of meteorology. Whether the task is weather forecasting, detailing local weather conditions, or performing climatic studies, the meteorologist relies on the availability of very precise measurements. The requirement for data is greater today than ever before because meteorologists use new technologies with greater capability and resolution, which need more data to be effective. Also, commercial and recreational activities, on land, in the air, and at sea, have expanded greatly in recent years, placing further demands on the available database. Weather systems are large scale, and subject to continuous modification, development, and movement. It is not unusual for weather systems in the North Pacific to move across North America to the North Atlantic, and then to Europe in just a few days, especially during the winter months. A weather system may undergo many changes as it moves–forming and reforming–and can be responsible for many different conditions. Thus, data from very large areas, often thousands of miles apart, goes into the preparation of local forecasts for a single area. There is a continuing need for data, land and marine, worldwide.

Recording Air Temperature, Group $1S_nTTT$

To obtain accurate air temperature readings, thermometers must be exposed in a stream of air fresh from the sea, which has not been in contact with or passed over the ship. There must be adequate shielding from sunlight, precipitation, and spray. Do not automatically go to the same deck location each time to whirl the hand-held sling– go wherever the exposure is best for the given weather conditions. If your vessel uses a fixed fan-ventilated psychrometer, there must be one on each side of the ship for exposure. We recommend a weekly muslin change for your wet-bulb thermometer. For a correct reading, the muslin should be damp, but not wet.

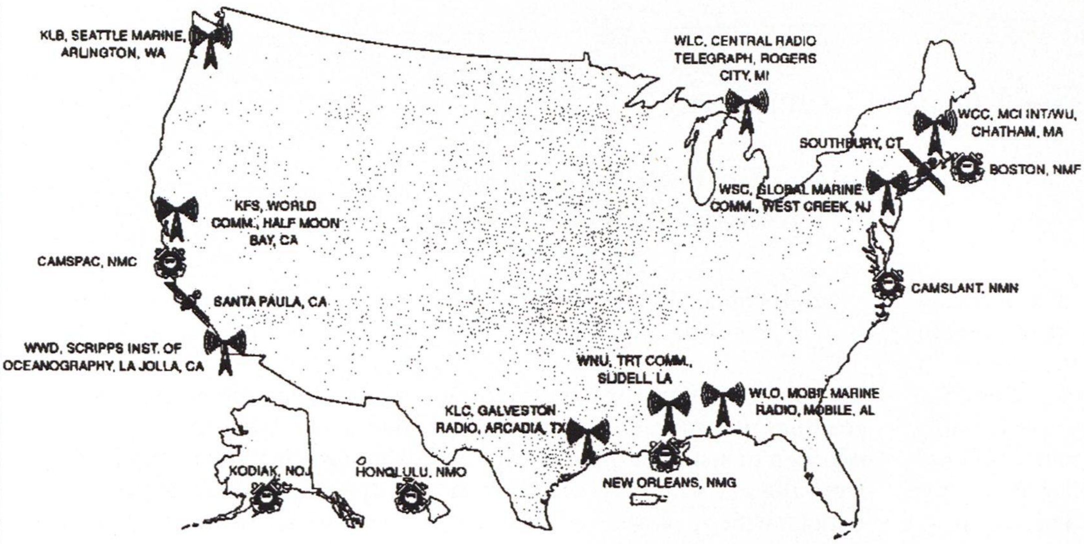
Measure air temperature to the nearest .1°C. Very accurate temperature data is needed for weather forecasting and global climate studies. The fishing industry also requires very accurate thermal data. Ships are the only source of temperature data for vast marine areas. PMOs carry replacement thermometer tubes and will readily supply these to you when needed.



When observing air and dew-point temperature make sure there is adequate shielding from the sun, rain and spray.

National Weather Service Voluntary Observing Ship Program

Relay of Ship Weather Reports



New Recruits
October–December, 1993

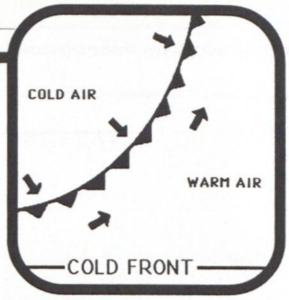
During the 3-month period ending December 30, 1993, PMOs recruited 46 vessels as weather observers/reporters in the National Weather Service (NWS) Voluntary Observing Ship (VOS) Program. Thank you for joining the program. For the year 1993, PMOs recruited VOS weather observers from 269 vessels—a very impressive number. The NWS VOS program received a record number of observations from ships during 1993. During August 1993, for the first time, over 40,000 ship reports were received at the NWS Telecommunications Gateway in Silver Spring, Maryland. We thank contributing ships officers for their tremendous effort.

Please remember that the basic weather reporting schedule for Voluntary Observing ships worldwide is four times daily—at 0000, 0600, 1200, and 1800 UTC. These are the "main synoptic" times, when numerical weather prediction models are initialized with data. The United States and Canada also have an important 3-hourly weather reporting schedule from coastal waters out 200 miles from shore, and from anywhere on the Great Lakes. The coastal zones mark the transition from land to marine weather, and can have very changeable conditions, including unique diurnal weather fluctuations. Whenever possible, please transmit weather reports from United States and Canadian coastal waters at 0000, 0300, 0600, 0900, 1200, 1500, 1800, and 2100 UTC. Coastal zones are not the only areas with data shortages. From the North Atlantic and North Pacific Oceans, more observations are needed at 0600 and 1200 UTC. These are late night/early morning reporting times. From May through November, the northern hemisphere hurricane season, reports from the tropics and the easterly trade wind belt (roughly 5°–35°N) are in short supply. Southern hemisphere reports (South Atlantic, Indian, and South Pacific Oceans) are also in short supply. There is also a shortage of data from the Arctic Ocean.

The two main methods of transmitting ship weather reports are (1) through INMARSAT Coast Earth Stations using NWS dial code 41, and (2) through U.S. Coast Guard shore radio stations using Simplex Teletype Over Radio (SITOR), plain language (recite the coded message using radiotelephone), or high frequency Morse Code (CW). The Coast Guard discontinued some medium frequency Morse Code (CW) operations July 31, 1993. A third method, through commercially operated shore radio stations (using SITOR or CW), is available as a back-up. Please contact any PMO or see NWS Observing Handbook No. 1, Chapter 4, "Transmitting The Observation To The National Weather Service" for more details. PMO addresses and phone numbers are listed on the inside back cover of this publication.

NATIONAL WEATHER SERVICE VOLUNTARY OBSERVING SHIP PROGRAM
NEW RECRUITS FROM 01-OCT-93 TO 31-DEC-93

NAME OF SHIP	CALL	AGENT NAME	RECRUITING PMO
ANNA	LAGU4	BARBER SHIP MANAGEMENT LTD.	JACKSONVILLE, FL
BAR' ZAN	A7EK	KERR STEAMSHIP CO.	NEWARK, NJ
BARRINGTON ISLAND	C6QK	ECUADORIAN LINES	NEWARK, NJ
BARTLETT	WY6244	ALASKA MARINE HIGHWAY	SEATTLE, WA
CAP TRIUNFO	3EWQ6	MANATEE MARINE AGENCY INC	MIAMI, FL
CAPE DECISION	WMGD	MILITARY SEALIFT COMMAND	NORFOLK, VA
CAPE HATTERAS	ELFY8	ZODIAC MARITIME AGENCIES LTD	NEW YORK, NY
CAPE ISLAND	WSZS	AMERICAN PRESIDENT LINES	HOUSTON, TX
CHARLES ISLAND	C6JT	A.E.M., E.L.I., BERTH 6, BLDG. 138	MIAMI, FL
CSL ATLAS	C6IL3	SPARROWS POINT SHIP AGENCY, LTD.	BALTIMORE, MD
DIAVOLEZZA	HBFA	NAVIOS SHIP AGENCIES INC.	NEWARK, NJ
EAGLE	YJWY5	BERGEN SHIP MANAGEMENT	BALTIMORE, MD
ELIZABETH OLDENDORFF	ELPF9	INTERNATIONAL SHIPPING CO	SEATTLE, WA
GREEN CEDAR	S6DO	MERIT STEAMSHIP AGENCY	SEATTLE, WA
HAMILTON K	8RFG		NEW YORK, NY
HEREFORDSHIRE	3ESU3	BILL LUKOWSKI STEAMSHIP AGENCY	BALTIMORE, MD
HUAL KARINITA	LAGK4	AUTOLINERS INC.	JACKSONVILLE, FL
ITB MOBILE	KXDB	SHERIDAN TRANS. CO.	NEWARK, NJ
JALAVIHAR	ATPG	INCHCAPE SHIPPING	BALTIMORE, MD
JEBEL ALI	A6MH	UNITED ARAB AGENCIES INC.	NEWARK, NJ
KANSAS TRADER	KSDF	PENN ATTRANSCO CORP.	HOUSTON, TX
KRISSA	3EXO4	TRANSCONTINENTAL/SEMCO SHIPPING AGENCY	MIAMI, FL
LEON	5MDL	JOHN S. CONNOR, INC.	BALTIMORE, MD
M/S MAASDAM	C6VF	HOLLAND AMERICA LINE WESTOURS INC.	NEW YORK, NY
MANILA FELIZ	DZPV	INTERNATIONAL SHIPPING CO	SEATTLE, WA
MERCHANT VICTOR	C6HL6	CROWLEY AMERICAN MARITIME CORP	MIAMI, FL
MOSTWEEN 7	LATX2	HUDSON STEAMSHIP CO. LTD.	NEWARK, NJ
NORD JAHRE TARGET	LAJO4	J. ASPEN SHIPPING	NEWARK, NJ
OMI DYNACHEM	KNJK	OMI CORP.	SAN FRAN., CA
PORT-AU-PRINCE	FNHU	VAN OMMEREN TANKERS	NEWARK, NJ
PROOF GALLANT	D5YO	LAVINO SHIPPING AGENCY	NEWARK, NJ
RHINE FOREST	ELFO3	GULF AND EASTERN SS CORP.	NEW ORLEANS, LA
ROYAL MAJESTY	3ETG9	ROYAL MAJESTY	MIAMI, FL
SAMUEL L. COBB	KCDJ	OCEAN SHIPHOLDING INC	SAN FRAN., CA
SANTA FE	LAGX2	FAROVI SHIPPING CORP.	MIAMI, FL
SEACON	NOCB	MASTER/SEACON	MIAMI, FL
SENSATION	3ESE9	CARNIVAL CRUISE LINE	MIAMI, FL
SHOWA MARU	ELIW2	SHOWA MARINE KOGYO LTD.-SKADURA BLDG. 4-7 NISHI	NEWARK, NJ
SINBAD	C6IF4	ADMANTHOS SHIPPING AGENCY, INC.	MIAMI, FL
STAR SKARVEN	LAJY2	A//S BILLABONG	MIAMI, FL
STARSHIP ATLANTIC	ELAJ4	PREMIER CRUISE LINES, LTD	BALTIMORE, MD
STARSHIP MAJESTIC	C6HK9	SUNSHINE SHIPPING	BALTIMORE, MD
SURYA KRIPA	VVCT	VARUN SHIPPING COMPANY LTD.	NEW ORLEANS, LA
USCGC BOUTWELL WHEC 719	NYCQ	COMMANDING OFFICER	SEATTLE, WA
USCGC MARIPOSA	NODP	COMMANDING OFFICER	SEATTLE, WA
WESTERN TIGER	LAKF4	WESTERN BULK SHIPPING	NEWARK, NJ



All times unless noted are UTC (universal time) and all miles are nautical. For additional detail, tropical cyclones will be covered in the annual reports from the tropical cyclone centers around the world. The weather summaries are based upon the track charts and Northern Hemisphere Surface Charts as well as ship reports, and attempt to highlight the most significant ocean features each month. The track charts are provided by NOAA's National Meteorological Center. If an extratropical storm is particularly bad for shipping, we may designate it as the Monster of the Month. The Gale Tables provided by the National Climatic Data Center at Asheville, NC, have been expanded to include U.S. ships reporting winds of 34 knots or more.

North Atlantic Weather
July, August, September 1993

July - The Azores-Bermuda High was a prominent climatic feature as is normal in summer. However, over the western North Atlantic it was slightly weaker than normal giving rise to anomalies as low as -6 millibars near 40°N, 50°W. The Icelandic Low usually disappears by July, but this year it was analyzed as a 1006-millibar center west of Norway. Storm track charts verified a flurry of cyclonic activity over the Grand Banks and in the Norwegian Sea.

These anomalies also existed in the upper atmosphere as well. Steering currents were nearly zonal in a trough south of Newfoundland but east of about 40°W. All of this translated into weak to moderate low pressure systems developing over the Grand Banks and moving east northeastward between Scotland and Ireland.

The month opened with a large 1040-millibar High centered over the Azores dominating most of the North Atlantic. It was flanked to the north by a moderate Low centered over Iceland. The pressure gradient of the High was tight enough to generate a strong northerly flow from the Irish Sea to the Strait of Gibraltar. Several vessels including ***Sloman Rider*** (41.4°N, 9.7°W) and the ***C6HD5*** (49.5°N, 6.2°W) ran into 45-knot (force 9) northerlies. This High continued to dominate for the next several days as its center meandered northeastward.

A Low developed over Hudson Bay on the 3rd and moved through the Gulf of St. Lawrence the following day. Once into the North Atlantic its movement was stymied by the semipermanent Azores High. Slowing on the 6th, it stalled on the 7th, tracked northward on the 8th and 9th. While the storm was not severe, its position over the shipping routes plus the intensified pressure gradients, enhanced by the High, did create a few problems east of the Grand Banks. For the most part, winds remained below gale force and seas below 3 meters (10 feet).

The remnants of a tropical depression moved into the Caribbean Sea on the 10th—enough left to affect both the ***Santa Paula*** (17.9°N, 70.7°W) and the ***Atlantic Ocean*** (19.2°N, 74.4°W) on the 11th when they encountered 36-knot (force 8) winds in 4-meter 13 foot. swells.

By the the 11th, the High weakened significantly and was squeezed into the southeastern North Atlantic while a series of small Lows dominated much of the weather from Nova Scotia to Norway. These rather local disturbances while not severe presented a continuously changing wind and sea pattern to vessels plying the northern trade routes. On the 11th, the ***CG2614*** (45.9°N, 59.9°W) ran into 40-knot (force 8) south southeasterlies while the following day the ***WXQ451*** measured 40-knot (force 8) northwesterlies near 43.2°N, 86.7°W. By the 17th, a good sized Low was analyzed in the Gulf of St. Lawrence with a circulation that extended south to the Carolinas and east to near mid ocean. The system generated 20-to 30-knot (force 6-7) southwesterlies out to 800 miles (1480 kilometers) southeast of its 990-millibar center. Most of this activity was along an associated cold front. The ***Green Island*** (36.5°N, 53.2°W) ran into 35-knot (force 8) southwesterlies in 5 meter (16 foot) swells. The system weakened on the 19th and the High began to reassert itself over a good portion of the Atlantic. This pattern continued when another system arrived over the Gulf of St. Lawrence from the interior of the

U.S. on the 24th. The 1000-millibar storm remained organized and moved across the Atlantic crossing northern Scotland on the 27th.

Casualties–Six show-jumping horses drowned in the mid Atlantic after breaking loose when the mv ***Alfama*** was caught in a storm in early July. The vessel had left Maderia for Lisbon on June 29th. Five Algerian fishermen drowned when the their trawler ***Hamza*** sank off Oran during a storm. The trawler left the Mediterranean Habibas Island with 6 tons of fish on the 12th. The storm caused the vessel to capsize and sink. Two of the 12 rescued fishermen were hospitalized.

The ***Zam Zam,*** a 2205 dwt general cargo vessel, had an engine breakdown in rough weather after leaving Djibouti on the 1st of July. They turned back towards port (Gulf of Aden) but had to abandon the sinking vessel.

August–The Azores Bermuda High was was even more extensive then normal, particularly near Ireland where +4-millibar anomalies were analyzed. Steering patterns in the upper atmosphere north of 40°N were nearly zonal. Hurricane Emily was a threat to shipping along the mid Atlantic coast of the U.S.

A semipermanent High dominated the North Atlantic during the first week. To its north, several weak to moderate Lows were seen in the Labrador Sea and Denmark Strait. To the south of the High, Tropical Storm Bret was making its way eastward toward Venezuela along the 10th parallel. On the 7th a small Low developed along a stationary front off the Carolinas but ran into the High and expired.

A 986-millibar Low in the Norwegian Sea combined with a 992-millibar center in the North Sea to create a rather large circulation which extended nearly to the Bay of Biscay on the 10th. The platform ***63118*** (58.10°N, 01.3°W) at 0300 on the 10th measured 42-knot (force 9) westerlies in 5-meter (17 foot) seas. Gales continued the following day as the system pushed northeastward. This system opened the door for a series of Lows to permeate the waters north of 45°N. While these systems not severe, they did generate winds in the force 6 to 7 range which requires some care and planning from vessels over the northern shipping lanes. With these Lows, the most severe weather is often found along the associated frontal systems. On the 13th at 0000, the ***Cumulus*** (56°N, 20°W) battled force 7 southwesterlies in 3-meter (10 foot) swells just ahead of a cold front associated with a 988-millibar Low to the north. This system continued to cause a few problems as it turned northward just east of Iceland. Another Low which formed west of Hudson Bay on the 11th swung northeastward and intensified as it moved across Hudson Strait on the 13th. The ***Henry Larsen*** in the Davis Strait reported northerlies at 36 knots (force 8) on the 13th while the ***Hubert Gaucher*** (60.8°N, 67.9°W) measured 46-knot (force 9) southwesterlies at 1800 on the 13th and 50-knot (force 10) westerlies at 0600 the following day. The Low gradually weakened over the next several days.

The progression of small Lows north of the subtropical High continued through mid month. On the 17th three distinct low pressure centers were analyzed north of 35°N. These pesky systems generated winds in the force 6 range with swells commonly running 2 to 5 meters (5 to 17 foot). In the 982-millibar Low east of Kap Farvel, conditions were rougher. The ***SLCH*** and ***Nara*** encountered 45-knot (force 9) winds in 5-to 8-meter (15 to 25 foot) seas at 1200 on the 17th. By 1800, the ***Nara*** was battling 50-knot (force 10) winds in 11-meter (36 foot) swells near 54.8°N, 31.0°W. This had become an unusually potent summer extratropical storm. At 2100 on the 17th, the ***OVYA2*** (60.3°N, 36.5°W) reported 44-knot (force 9) winds in 6-meter (20 foot) seas. The ***Hudson*** had a rough day on the 18th. At 0000 near 56.2°N, 25.7°W, they reported 55-knot (force 10) west southwesterlies in 8-meter (26 foot) seas. Six hours later conditions were about the same as the vessel detoured to the south. Finally by 1200, winds were down to 44 knots (force 9) and seas slacked off to 3 meters (10 feet). However, they continued to battle these weather conditions through the 19th as the storm made its way across Iceland. It finally began to weaken on the 20th.

During the last third of August, several Highs dominated the North Atlantic although a number of weak Lows came to life off Newfoundland and Labrador. In the tropics and subtropics Hurricane Emily and tropical Storm Dennis provided some weather problems.

Casualties–Hurricane Emily (inside back cover) caused local damage on the Outer Banks of North Carolina, mainly in the form of uprooted trees and torn off roofs. The hardest hit was Hatteras Island where there was extensive flooding as north winds pushed the wide, shallow waters of Pamlico Sound over unprotected land. Tropical Storm Cindy was responsible for two deaths on the French Caribbean island of Martinique.

Some 3,000 people were left homeless in the north as the storm cut bridges and buried roads under mudslides.

September—The Azores-Bermuda High remained dominant although it did not extend as far eastward as normal this September, resulting in negative anomalies of as much as -6 millibars in the Bay of Biscay. The Icelandic Low centered in the Foxe Basin just west of Baffin Island resulting in anomalies down to -8 millibars in that area. The 500-millibar climatic chart showed that the steering currents ran in a general west to east direction between about 40°N and 60°N with a slight indication of a trough off the coast of Europe.

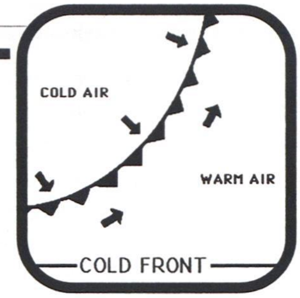
As the month began, Hurricane Emily threatened the Eastern Seaboard of the U.S. On the 1st, the ***Oleander***, ***J. Dennis Bonney*** and the ***Thompson Lykes*** were all southeast of the eye and battling gale force winds in 4- to 8- meter (13 to 26 foot) swells. An extratropical Low near 52°N, 30°W at 0000 on the 4th was occupying the attention of the ***Viva*** and ***Star Stronen***. The ***Viva*** reported in from the 3rd through the 7th as it moved from 47°N, 40°W toward the Bay of Biscay. Their winds were generally beneficial from a westerly direction at about 35 to 40 knots (force 8). The worst conditions occurred on the 7th at 0000 when they measured 50-knot (force 10) westerlies in 8-meter (25 foot) seas. Basically they remained south of the east southeastward moving Low which coincidentally reached a 978-millibar peak at 0000 on the 7th near 49°N, 14°W. The storm then recurved through the Irish Sea on the 8th and began to weaken as it brushed western Scotland.

Tropical Storm Floyd began north of Puerto Rico on the 6th but didn't achieve tropical storm status until the 8th as it crossed the 30th parallel near 70°W, heading northward. It swung east northeastward the following day. Floyd remained tropical until the 11th when it turned extratropical. The following day it deepened to 971 millibars as it approached the English Channel. Needless to say the Low was creating a few problems. On the 13th at 1200 the ***Galveston Bay*** (50.3°N, 00.5°N) encountered 35-knot (force 8) southerlies. By this time the central pressure of the storm had dipped to 968 millibars as it neared the north coast of France. In general winds on the 12th and 13th ranged from 40 to 55 knots (force 9 and 10) while swells up to 9 meters (29 feet) were being reported. Among the vessels that reported steadfastly despite the conditions were the ***Thorsaga***, ***Canberra***, and ***Nedlloyd Europa***. The weather improved on the 14th.

On the 14th an atmospheric wave developed along a stationary front in eastern Ontario. It moved east northeastward to off the southern Labrador coast the following day. At 1200 on the 15th, its central pressure was 992 millibar and 24 hours later it was down to 974 millibars and dropping. By the 17th, storm force winds were common as the 962-millibar Low swung south of 50°N near 35°W. The ***Hofsjokull*** experienced 44-knot (force 9) winds on the 16th, but at 0900 on the 17th near 55.3°N, 46.9°W, they ran into 52-knot (force 10) northwesterlies. At 1200 they reported 68-knot (force 12) northerlies in moderate rain. Three hours later their winds were back to 44 knots (force 9). Storm force winds were also reported by ***OUEU***, ***Charles Darwin***, ***Lackenby***, ***Hettstedt*** and ***Century Highway No. 5***. Two vessels reported force 10 winds. Conditions weren't much better on the 18th although the Low did start to fill. At 1200 on the 18th, the ***Bonn Express*** (50.4°N, 33.2°W) ran into 50-knot (force 10) northwesterlies in 4-meter (13 foot) seas and 10-meter (32 foot) swells. By this time, the storm turned northeastward and weakened as the center bypassed the British Isles. The storm remained potent through the 21st.

During the last part of the month, a couple of moderate Lows moved through the Denmark Strait and into the Labrador Sea. A large High established itself over the central North Atlantic forcing storm centers to remain north of about 55°N. As the month came to a close, a 982-millibar Low moved past Kap Farvel along the 60th parallel. The ***OYZC*** (60.4°N, 42.3°W) at 1800 on the 29th hit 43-knot (force 9) northerlies while the following day the ***Hual Rolita*** (46.30-°N, 13.6°W) was buffeted by 40-knot (force 8) westerlies in 2.5-meter (8 foot) swells.

Casualties—The mv ***Mirian*** took water in its engine room in a fierce Atlantic storm off northern Spain on the 12th. The crew was taken off unhurt by helicopter and the vessel sank somewhere near 45.8°N, 08.3°W. The ***Tonala*** had a rough month. After suffering heavy weather damage in Emily, it struck Canso Lock, Port Hawkesbury, Nova Scotia on the 6th. It was reported that during Tropical Storm Gert nine large fishing vessels were destroyed on the 15th along the coast of Nicaragua and Costa Rica. Gert was also partly responsible for as many as 70 deaths in Mexico. Most were the result of the flooding and torrential rains which began on the tail of the hurricane and persisted for 2 weeks.



North Pacific Weather
July, August, and September 1993

July—The usually dominant Pacific subtropical high was centered slightly east of its normal position while a 1010-millibar Low was centered over the Aleutians. These two factors resulted in anomalies of up to +4 millibars over the Gulf of Alaska and -4 millibars in the Aleutian Islands. While the Aleutian Low was comprised of several Lows, one in particular meandered in the region for more than a week. The steering currents in the upper atmosphere north of 35°N were influenced by a trough over the Bering Sea and a ridge over the northeastern North Pacific.

The month opened with a 980-millibar Low east of the Kamchtaka Peninsula. A secondary center developed rapidly to the east and the system caused a few headaches for shipping. At 0600 on the 1st, the ***Sealand Independence*** (45.8°N, 164.5°W) ran into 36-knot (force 8) southerlies while battling 4.5 meter (15-foot) swells. Meanwhile, the ***USCGC Rush*** (55.2°N, 156.1°W) at 0300 on the 2nd measured force 8 winds in 3.5 meter (12-foot) swells. Eventually the storm merged into a single 980-millibar center over the eastern Bering Sea. It filled slowly but maintained its circulation for several days as it moved northward.

A large semi-permanent High dominated the eastern North Pacific for the next few weeks. This is usually good news for mariners. However, that gradient created off the coast of California was responsible for gale force winds between about 35°N and 42°N along the coastal route. These winds were mainly out of the north at 35 to 40 knots (force 8) while swells ran to 4 to 6 meters (13 to 20 feet). This situation lasted from about the 5th through the 16th. The vessels that reported these conditions included the ***Green Harbour***, ***Sealand Spirit***, ***Cochise***, ***New Horizon***, ***Wecoma***, ***Arco Fairbanks***, ***Baltimore Trader*** and ***President Lincoln*** among others. To the south during this period, Hurricane Calvin came to life.

On the 17th, a 989-millibar Low was analyzed near 47°N and the dateline. The ***Hanjin Keelung*** (39.8°N, 179.7°E) ran into 35-knot (force 8) north northeasterlies in 7-meter (23 foot) seas. The interesting feature of this storm was its movement. It remained in the central Aleutian region until the 25th. During this period it turned three counterclockwise loops and its central pressure varied from 980 millibars to 1002 millibars. It reached its lowest pressure on the 20th. On this date the ***Skaugran*** (43.7°N, 165.8°W) measured a 45-knot (force 9) southwesterly in 3-meter (10 foot) swells. By the 25th the meandering 1002-millibar Low had made up its mind and moved over the Alaska Peninsula. The following day it turned into the Gulf of Alaska and headed southeastward as a weak Low. Except for local gales reported by the ***President Jackson***, ***President Lincoln*** and ***President Polk***, the remainder of the month was fairly quiet outside the tropics.

Casualties—Torrential downpours battered South Korea for a 3-day period around the 11th. A total of six people were killed, mostly in flooding. The mv ***Taisei*** collided with the container vessel ***Cosmos*** in dense fog near Kominase Island, Inland Sea on the 8th.

August—The climatic picture was nearly normal in the Pacific this month. The subtropical Pacific High was centered a few hundred miles east of its normal position and pushed more into the Gulf of Alaska than usual but overall it was a typical August. At 500 millibars, a trough was noticeable just west of the dateline extending from the Bering Sea to about 30°N, with a slight ridging around 140°W. In the tropics both the eastern and western North Pacific were active.

The month opened with the ***Marchen Maersk*** (41.0°N, 153.5°E) battling 39-knot (force 8) southeasterlies in 3.5-meter (12 foot) seas. This was associated with a warm front extending from a double-centered Low off Hokkaido. The system, however, weakened as it headed northeastward into the Bering Sea. By the 3rd Typhoon Robyn was moving through the Caroline Islands. It developed into a potent typhoon and a few days later Tropical Storm Steve formed in its wake. The ***President Lincoln*** eastbound ran into some rough weather on the 8th and 9th. Although the weather analysis showed a rather small, weak Low centered near 35°N, 153°E at 1200 on the 8th, the ***President Lincoln,*** some 300 miles to the west northwest, was measuring 44-knot (force 9) easterlies in 4-meter (13 foot) seas. Similar conditions had already been reported by the ***President Jefferson*** on the 7th and 8th in the same area. This vessel continued to battle force 8 to 9 winds in 5-meter (16 foot) swells over the next 2 days as it headed northeastward. The swells were coming out of the east. The Low itself looked rather innocuous but the gradient between it and a 1028-millibar High centered over the Kurils was tight enough to create some headaches.

Meanwhile the ***President Grant*** (34.3°N, 129.1°E) was close enough to the circulation of Typhoon Robyn at 2100 on the 9th to encounter 50-knot (force 10) northeasterlies in 4.5 meter (15 foot) seas. The ***LNG Taurus*** (31.5°N, 133.5°E) also encountered Robyn at 0000 on the 10th and reported 50-knot (force 10) southerlies in 9-meter (29 foot) swells.

During the following week, Hurricanes Keoni in the Central North Pacific and Fernando in eastern waters came to life. Also a weak extratropical system moving into the central Aleutians deepened to 988 millibars on the 13th and further to 982 millibars the following day over the Alaska Peninsula. This increase in strength was testified to by the ***President "Ike" Eisenhower*** (41.9°N, 172.5°W) 24 hours later. The ***Ike*** reported 44-knot (force 9) southwesterlies while the ***Tai Sahn*** ran into 39-knot (force 8) westerlies in 3.5-meter (12 foot) seas. The system continued to create problems on the 15th as it slowly moved over the Alaskan mainland. This was followed by another potent summer extratropical Low on the 17th.

This Low came to life near 48°N, 170°E late on the 16th. The following day as it swung east northeastward its central pressure plunged to 982 millibars and then to 974 millibars 24 hours later. On the 17th, the ***Solar Wind, Sealand Endurance*** and ***Margrethe Maersk*** encountered force 8 winds in 3- to 6-meter (10 to 20 foot) swells. They all reported similar conditions on the 18th as did the ***President Jackson*** and ***OOCL Envoy***. The following day as the now 970-millibar system swung northwestward off Nunivak Island in the eastern Bering Sea, the ***OOCL Explorer*** (53.4°N, 147.7°W) and ***President Jefferson*** joined the list. This was a good gale-producing storm, which finally abated on the 20th. By the 21st, Keoni had crossed the International Dateline to become a typhoon while both Greg and Hillary had attained hurricane status in eastern waters.

A situation somewhat similar to last month was set up on the 24th when a 1032-millibar High established itself in the eastern North Pacific. The pressure gradient along the California coast was strong enough to generate northerly gales (force 8) between about 35°N and 40°N near 126°W. These conditions along with 3.5- to 4-meter (11 to 13 foot) swells were encountered by the ***Kenai*** and the NOAA ship ***McArthur***.

Before the month was out, Typhoon Vernon developed in the western North Pacific and an extratropical system from the Sea of Japan intensified over the Aleutians. On the 27th this storm had a central pressure of 979 millibars near 53°N, 175°W. It remained potent and nearly stationary on the 28th then began to fill as it drifted southward.

Casualties—On the 11th, the ***Oriental Lion*** (6,970 tons gross) and the ***Dae Chang*** (1,247 tons gross) collided in Chinhae Bay. Both were sheltering from Typhoon Robyn. A similar incident occurred between the ***Hsiang Ming*** and ***Koecki Maru*** in Satsukawa Bay. The container vessel ***Singapore Bay*** suffered heavy weather damage on the 9th while on passage from Yokoham to Hong Kong. Hawaii was brushed by Hurricane Fernanda and there were reports of 4.5-meter (15 foot) high waves crashing ashore and a number of coastal roads were flooded. The Thai vessel ***Taveechai Marine*** sank in the Gulf of Thailand near 10.6°N, 101.4°E due to bad weather on the 21st. The crew of 22 persons were rescued by the container vessel ***Sri Samut*** and the tanker ***Sun Aronia***. During Typhoon Tasha, the ***Interhill King*** had its cargo slip and developed a severe list on the 21st near 17.1°N, 117.2°E. The 21 crew members were plucked to safety by helicopter.

September–The Pacific subtropical high usually covers a good portion of the North Pacific on the climatic charts during this month. This September it stretched northward and over the northeastern North Pacific and was centered close to the Gulf of Alaska. It was also more intense than normal resulting in positive anomalies of up to 10 milibars in this region. The Aleutian Low was confined mainly to the Bering Sea. The surface features were reflected on the 500-millibar climatic chart with a deep trough centered at the International Dateline and a ridge over the Gulf of Alaska region.

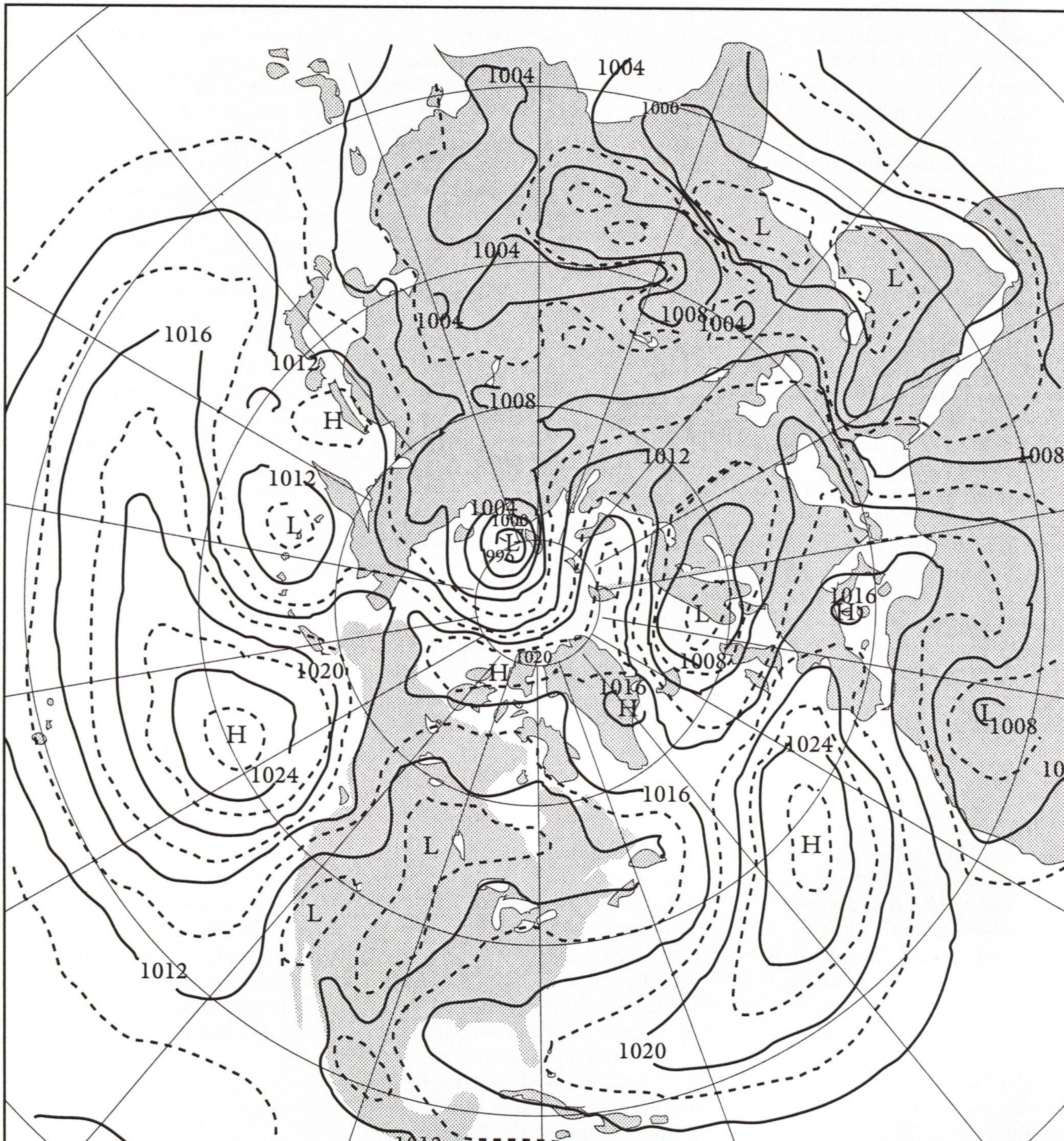
The month opened with a large 1032-mb High centered over the Gulf of Alaska, Typhoon Yancy clobbering the Ryukyu Islands and Hurricane Jova off the tip of Baja California. As the Gulf of Alaska High weakened over the next few days another strong anticyclonic built in over the Kamchatka Peninsula. An extratropical system which had come to life east of the Kurils on the 2nd combined with a second storm near 50°N, 165°W on the 5th to produce a potent 982-millibar Low. At 0600 on the 5th, the ***Sealand Producer*** (46.1°N, 157.0°W) measured southerly winds at 42 knots (force 9). Seas were estimated at 4.5 meters (15 feet). The NOAA ship ***Surveyor*** and the ***Sea Light*** ran into gale force winds during this storm. The system made its way northward over the Alaska Peninsula and along the west coast of Alaska.

This storm developed on the 5th as a wave along a front off Honshu and briefly intensified on the 10th near 45°N, 180°. At 1200 the ***Sealand Hawaii*** (42.5°N, 179.0°E) ran into 35-knot (force 8) westerlies in 3-meter (10 foot) swells. The ***8K5K*** (49.7°N, 176.)°EW) at 0600 reported 43-knot (force 9) northeasterlies in 7-meter (23 foot) swells. The Low weakened rapidly by the 11th.

In the tropics on the 13th, Typhoon Abe was threatening vessels in the South China Sea while Hurricane Kenneth and Lidia were pounding eastern Pacific waters. To the north a large double-centered High covered most of the Pacific with a 985-millibar Low dominating the Bering Sea. While several weak to moderate extratropical system developed over the next 2 weeks and force 6 to 7 winds were occasionally reported, it was in general a rather peaceful period along the northern shipping lanes. The major weather feature over the Pacific during this period was Typhoon Cecil. Cecil recurved toward the northern latitudes on the 28th and merged with two extratropical centers to become a potent winter type storm. On the 28th, the 976-millibar center crossed the 45th parallel near 165°E. Gale force winds had already been reported on the 27th by the ***President Monroe***, ***Westwood Marianne***, and ***World Wing #2***. The ***Pacific Emerald*** (49.2°N, 166.6°E) measured 45-knot (force 9) southerlies. At 0600 on the 28th, the ***President Truman*** (40.1°N, 166.7°E) hit 58-knot (force 11) southerlies in 8-meter (26 foot) seas. The ***Liberty Victory*** ran into force 10 winds in 4.5-meter (15 foot) seas near 49.3°N, 159.4°E at 1200 on the 28th. The large Low was right over the heart of the shipping lanes. The ***Virginia*** battled 7.5-meter (24.5 foot) swells in storm force winds while the ***Westwood Marianne*** measured 56-knot (force 10) southerlies both on the 28th. Other vessels reporting gale to storm force winds and highs seas included the ***Pacific Emerald***, ***OOCL Explorer***, ***President Adams***, and the ***Diana***. These conditions persisted through the 29th as the storm swung east northeasterward along the central Aleutians. It also gave rise to a secondary center which soon became dominant in the Bering Sea.

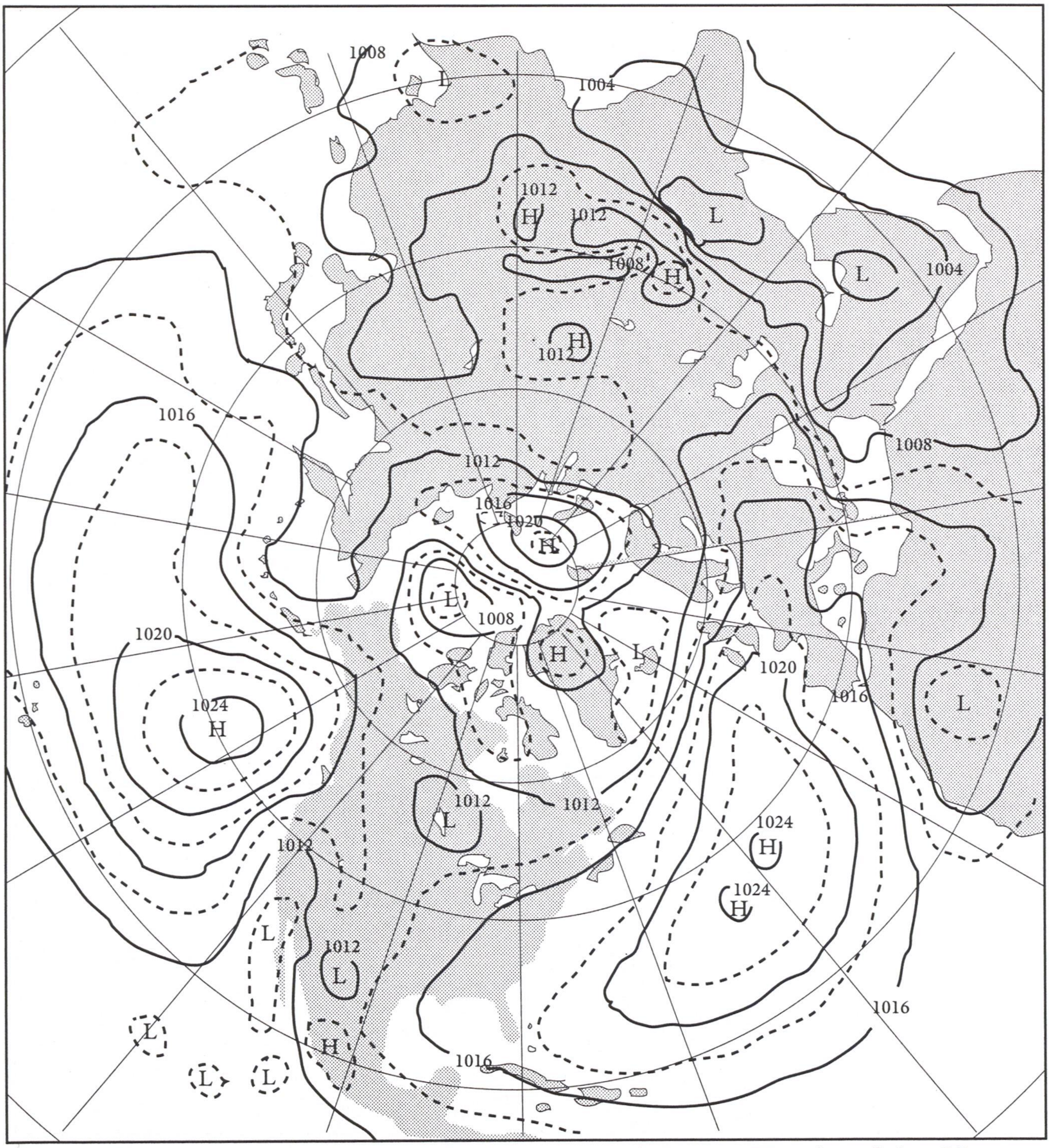
Casualties–Typhoon Yancy destroyed more than 570 homes in southern Japan, with a least 42 deaths reported. Ship casualties include the ***Rainbow Star*** which grounded as did the mv ***Tong Fung*** in Kagoshima Bay. Yancy was considered one of the fiercest typhoons to hit Japan since World War II. The Panamanian freighter ***Heng Yun*** sank in a storm off southern China on the 14th. All 21 crew members were rescued as the vessel foundered near the Taiwan Strait. The bulk carrier ***Anderson*** sank during Typhoon Becky on the 17th near 21.6°N, 113.6°E. One survivor was picked up. At least 24 crew members were missing. The survivor was rescued by a passing vessel after hours in heavy swells. A total of 55 people were saved from the ocean around Hong Kong in 11 dramatic rescues. Those rescued included four Royal Air Force officers whose helicopter had to be ditched after engine failure while searching for a fishing vessel. Just a single member of the 24-man crew of the ***Feng Huang Shan***, which sank 7 miles south of Hong Kong in Becky, was rescued. In all, 70 mariners remained missing including crews of two Chinese freighters and two Chinese fishing boats which sank southwest of Hong Kong. Some of the recovered bodies had been half eaten by sharks.

July 1993



These Charts were provided by John Kopman and Vernon Kousky of the Climate Analysis Center from the Climate Diagnostics Bulletin

August 1993



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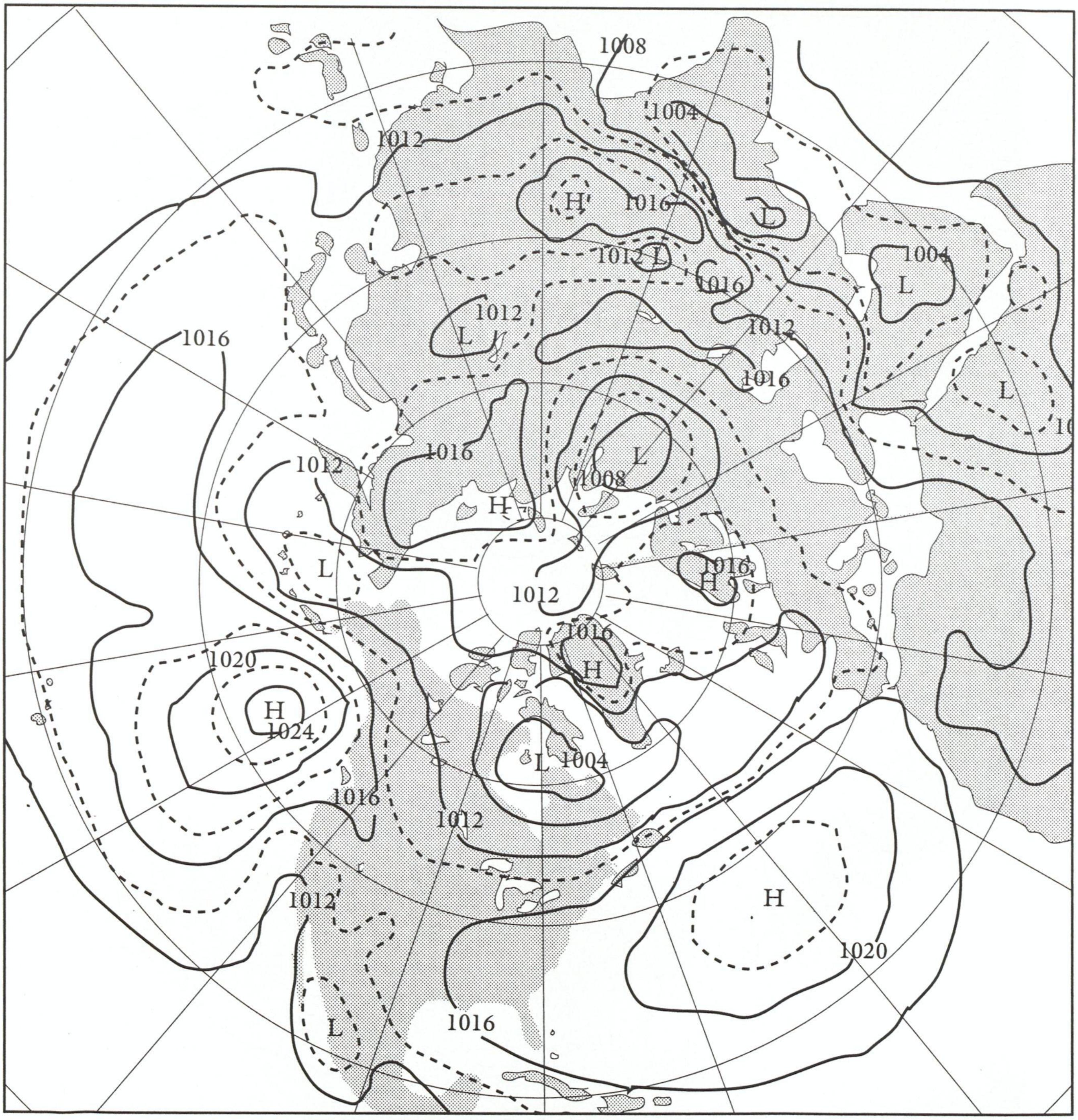
September 1993



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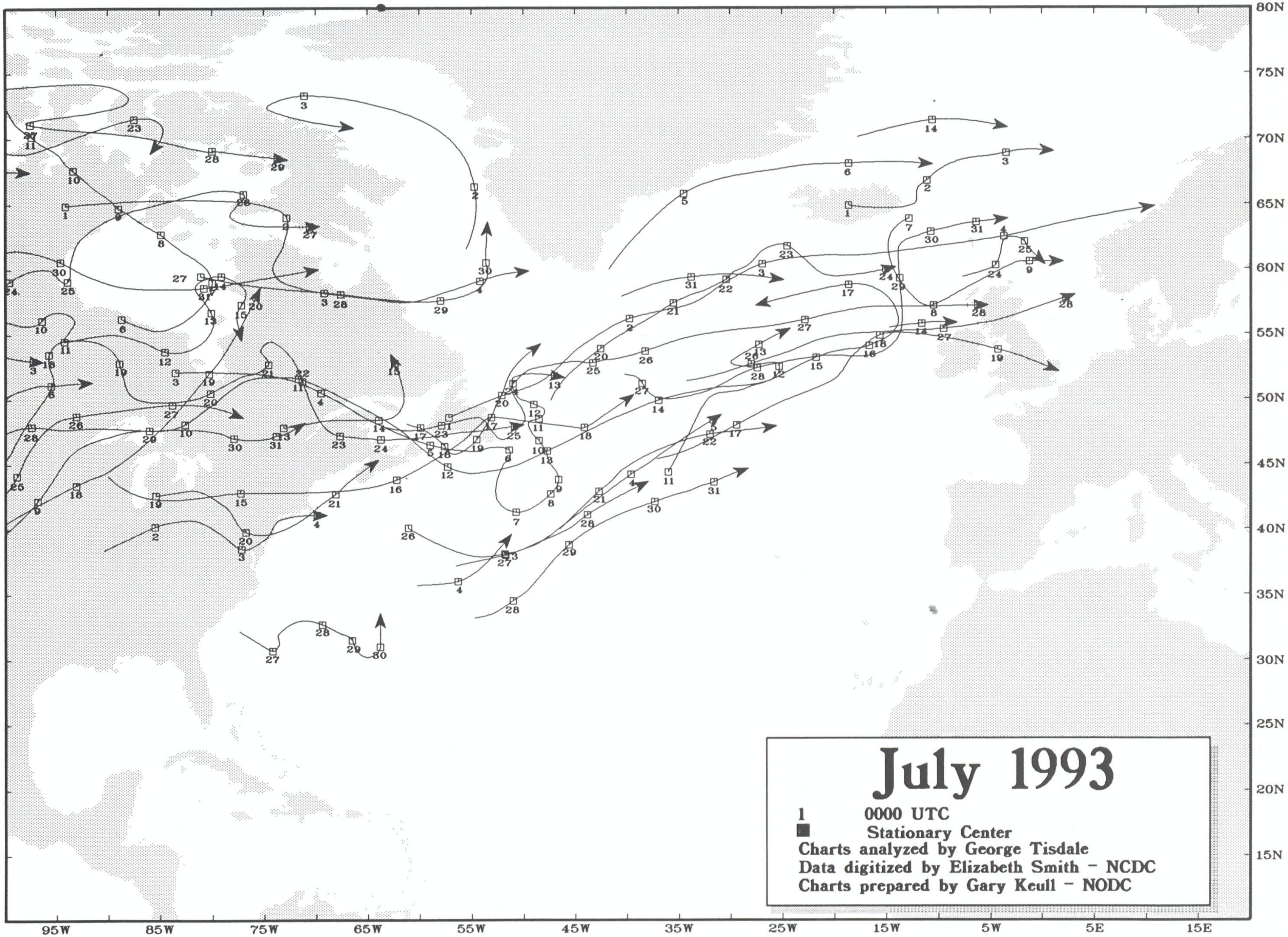
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



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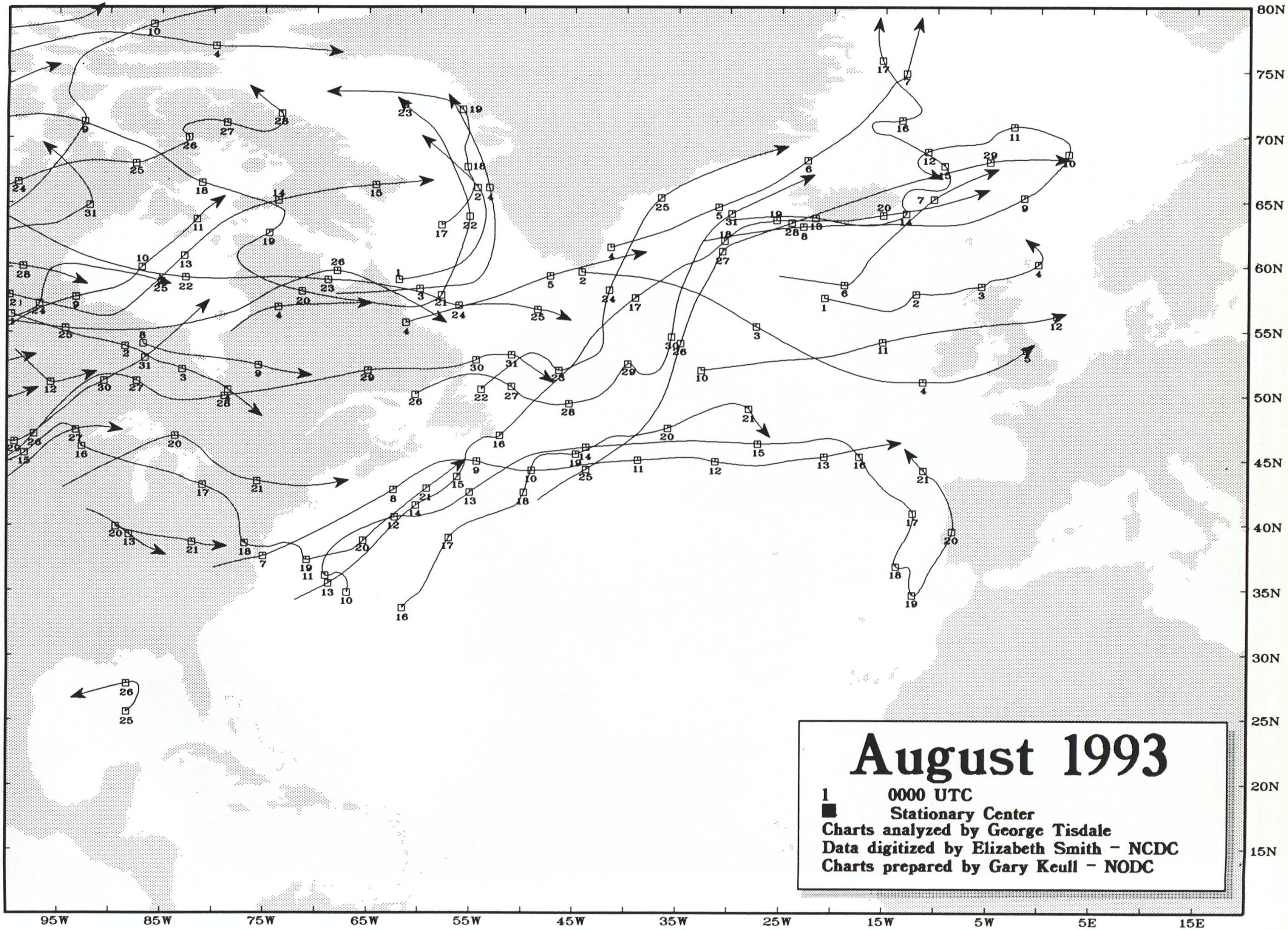

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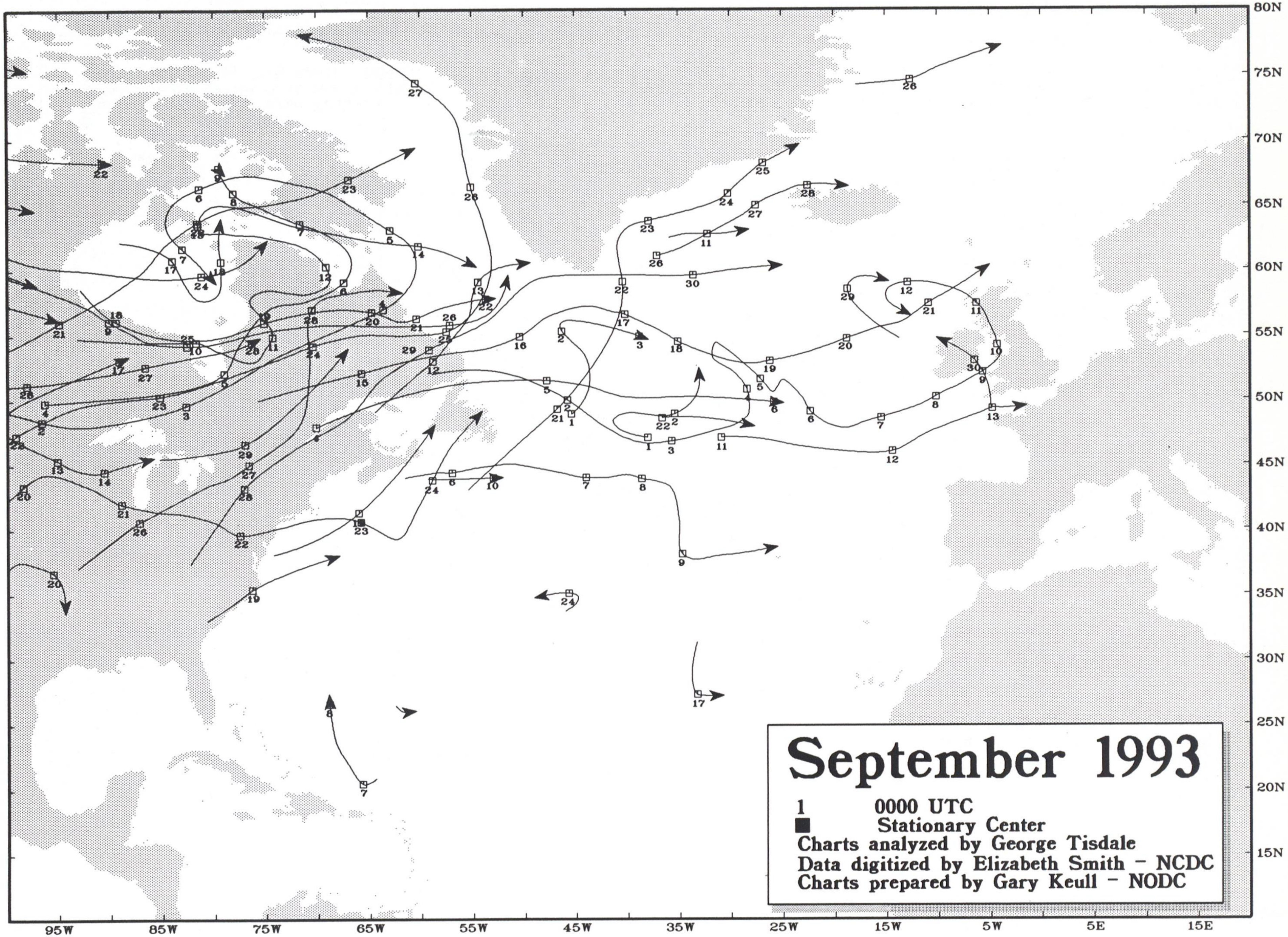
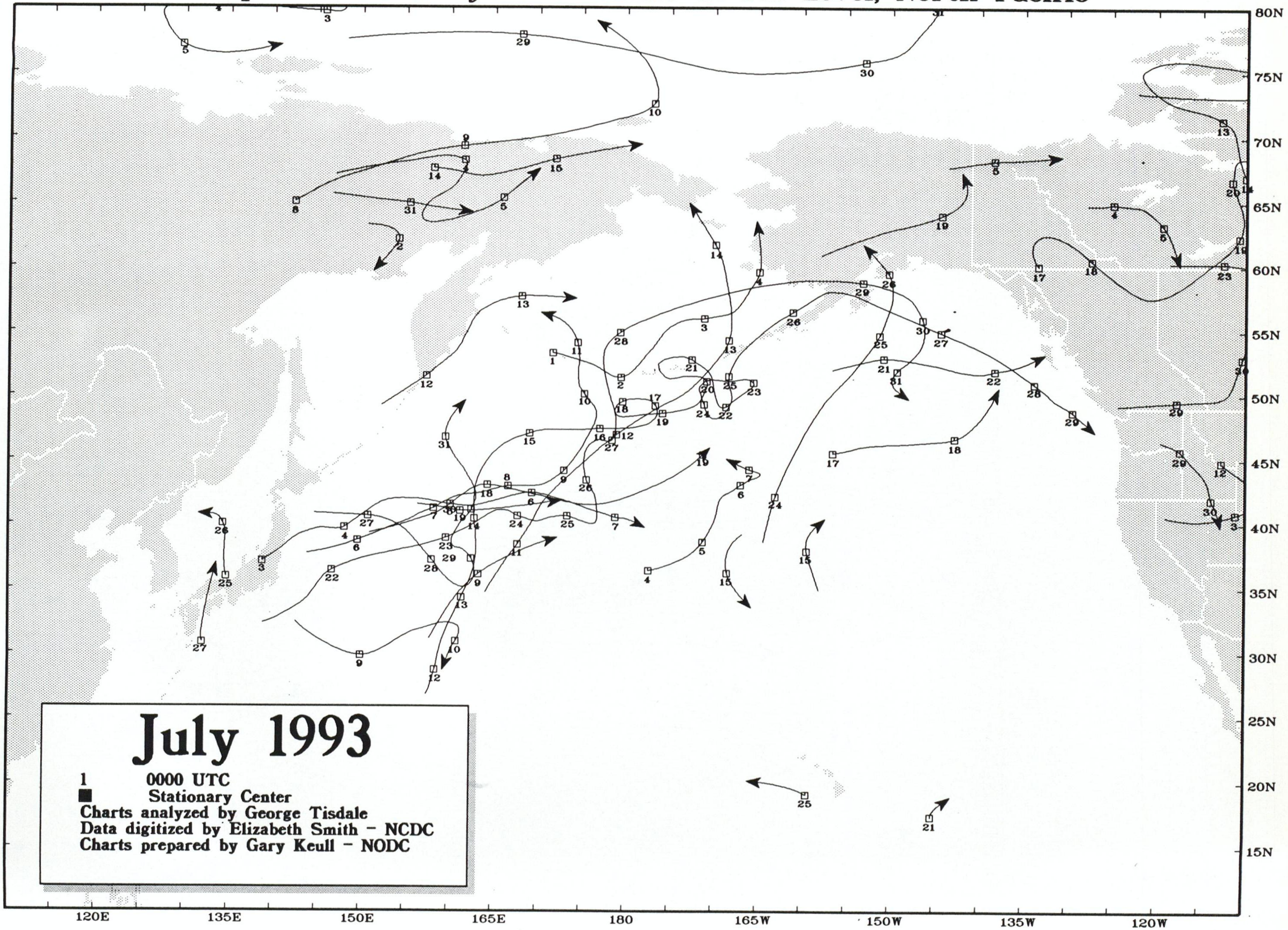
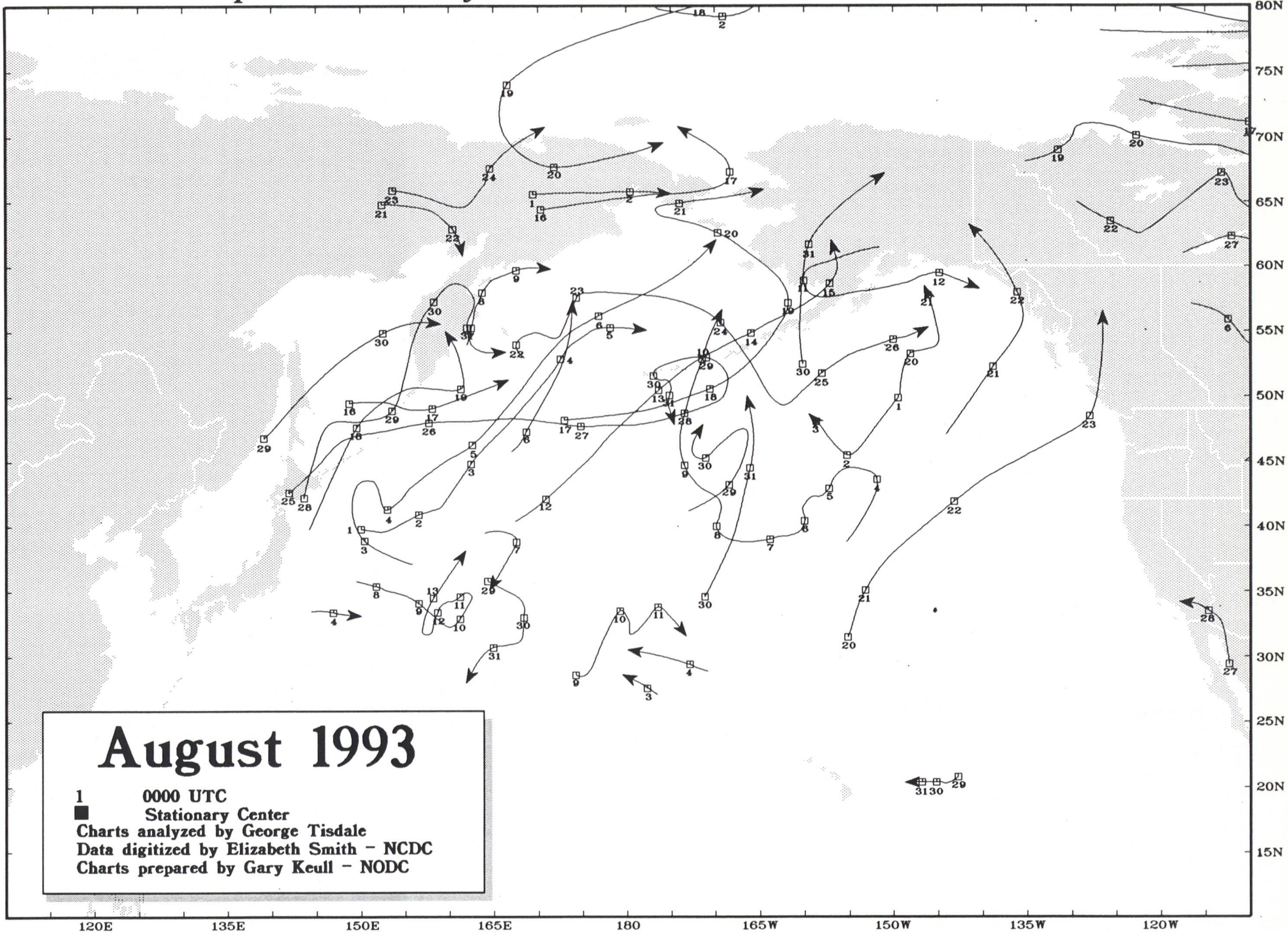


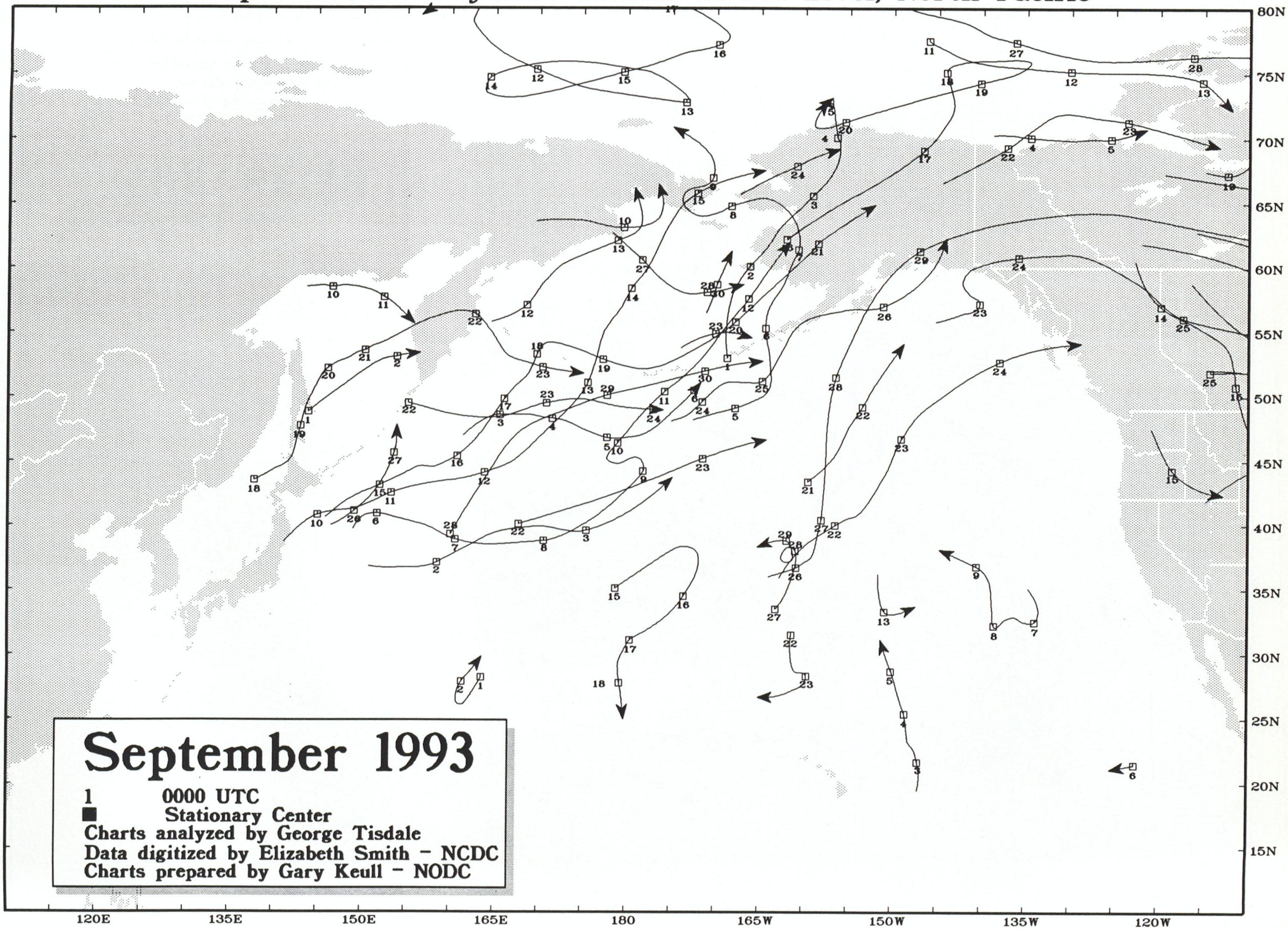
Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



July, August and September 1993

	RADIO	MAIL
1ST LT ALEX BONNYMAN	44	11
1ST LT JACK LUMMUS	70	94
A. V. KASTNER	143	
ACADIA FOREST	92	104
ACE ACCORD	32	18
ACT 7	201	
ACT I	144	
ADABELLE LYKES	62	123
ADRIAN MAERSK	12	46
ADVANTAGE	1	27
AFRICAN CAMELLIA	50	195
AGULHAS	39	79
ALASKA RAINBOW	24	100
ALBE		120
ALBEMARLE ISLAND	23	
ALBERNI DAWN	32	
ALBERT MAERSK	11	27
ALDEN W. CLAUSEN	20	
ALLIGATOR AMERICA	24	
ALLIGATOR COLUMBUS	50	57
ALLIGATOR EXCELLENCE	100	
ALLIGATOR FORTUNE	43	
ALLIGATOR GLORY	65	45
ALLIGATOR HOPE	85	168
ALLIGATOR JOY	79	33
ALLIGATOR LIBERTY	106	
ALLIGATOR PRIDE	81	96
ALLIGATOR TRIUMPH	72	32
ALMANIA	25	11
ALMEDA STAR	59	
ALPENA	148	196
ALTAMONTE	40	18
AMERICA STAR	142	
AMERICAN CONDOR	96	206
AMERICAN FALCON	94	148
AMERICAN KESTREL	43	
AMERICAN MARINER	13	
AMERICAN MERLION	12	
AMERICAN VETERAN	9	11
AMERICANA	72	75
AMERIGO VESPUCCI	36	54
AMULET	54	39
ANAHUAC	3	
ANDERS MAERSK	89	202
ANNA	13	
ANNA MAERSK	41	24
APJ SHALIN	99	173
ARABIAN SENATOR	144	
ARCO ALASKA		29
ARCO ANCHORAGE	19	29
ARCO CALIFORNIA		55
ARCO FAIRBANKS	20	24
ARCO JUNEAU	15	
ARCO TEXAS	32	13
ARCTIC OCEAN	122	56
ARGONAUT	45	54
ARILD MAERSK	53	
ARMCO	144	163
ARNOLD MAERSK	7	23
ARTHUR M. ANDERSON	114	120
ARTHUR MAERSK	1	40
ASHLEY LYKES	37	47
ASIAN SENATOR	81	
ASTERIKS	10	
ATIGUN PASS	51	18
ATLANTA BAY	40	
ATLANTIC CARTIER	61	
ATLANTIC COMPASS	86	
ATLANTIC CONVEYOR	85	
ATLANTIC OCEAN	22	39
ATLANTIS II	34	
AUSTRAL RAINBOW	13	13
AUTHOR	2	
AVELONA STAR	43	
AXEL MAERSK	23	117
AYA II	63	
B.T. ALASKA	91	
BAAB ULLAH	13	
BALTIC SUN	40	
BALTIMORE TRADER	143	151
BARBARA ANDRIE	164	205
BAY BRIDGE	103	124
BEBEDOURO	76	
BIBI	139	

	RADIO	MAIL
BLUE HAWK	1	
BLUE RIDGE	56	119
BOGASARI LIMA	253	
BONN EXPRESS	165	
BOSPORUS BRIDGE	126	172
BOVEC	120	
BP ADMIRAL	29	
BP ADVENTURE	154	
BRAZILIAN REEFER	34	146
BRIDGETON	85	
BRIGIT MAERSK	15	54
BROOKLYN BRIDGE	147	87
BROOKS RANGE	40	
BRUCE SMART	41	267
BT NAUTILUS	1	
BUCKEYE	270	337
BUNGA KANTAN	6	
BUNGA KESIDANG	6	
BURDUR		12
BURNS HARBOR	425	448
CALCITE II	32	26
CALIFORNIA CERES	82	
CALIFORNIA HERMES	85	32
CALIFORNIA LUNA	80	
CALIFORNIA MERCURY	77	
CALIFORNIA ORION	103	106
CALIFORNIA PEGASUS	60	
CALIFORNIA STAR	130	
CALIFORNIA TRITON	82	
CALIFORNIA ZEUS	56	
CANADIAN LIBERTY	72	45
CAPE HUDSON	33	21
CAPE MAY	118	
CARINA	37	48
CARLA A. HILLS	90	106
CARMEL	12	
CAROLINA		82
CARTAGENA	112	
CASON J. CALLAWAY	207	230
CASSIA	47	33
CATHAY SPIRIT	64	
CCNI ANTARTICO	18	
CEDRELA	40	20
CELEBRATION	46	50
CENTURY HIGHWAY #2	98	33
CENTURY HIGHWAY NO. 1	21	
CENTURY HIGHWAY NO. 5	251	
CENTURY HIGHWAY_NO. 3	48	
CENTURY LEADER NO. 1	14	
CGM LORRAINE	25	
CHACABUCO	55	65
CHARLES LYKES	32	181
CHARLES M. BEEGHLEY	80	91
CHARLES PIGOTT		107
CHARLESTON	51	12
CHARLOTTE LYKES	52	133
CHELSEA	14	11
CHEMICAL PIONEER	128	83
CHERRY VALLEY	5	
CHESAPEAKE TRADER	94	60
CHESTNUT HILL	20	45
CHEVRON ANTWERP	10	
CHEVRON ATLANTIC		123
CHEVRON BURNABY	43	100
CHEVRON CALIFORNIA	36	47
CHEVRON COLORADO	79	36
CHEVRON EDINBURGH	46	155
CHEVRON FELUY		91
CHEVRON MISSISSIPPI	76	89
CHEVRON PACIFIC	45	70
CHEVRON STAR		66
CHIQUITA BOCAS	46	
CHIQUITA CINCINNATIAN	81	92
CHIQUITA ITALIA	122	
CHIQUITA JEAN	101	42
CHIQUITA SCANDINAVIA	63	
CHOAPA	6	
CIELO DI FIRENZE	13	
CLEMENTINA	41	
CLEVELAND	11	
CO-OP EXPRESO	49	12
COAST RANGE	17	28
COASTAL CORPUS CHRISTI	2	18
COASTAL EAGLE POINT	40	

	RADIO	MAIL
COASTAL MANATEE	27	11
COLIMA		33
COLLEEN SIF	170	162
COLUMBIA BAY	116	
COLUMBIA STAR	364	267
COLUMBUS AMERICA	122	
COLUMBUS AUSTRALIA	125	
COLUMBUS CALIFORNIA	183	
COLUMBUS ISELIN	30	
COLUMBUS NEW ZEALAND	179	
COLUMBUS OHIO	29	
COLUMBUS QUEENSLAND	191	
COLUMBUS VICTORIA	188	
COLUMBUS VIRGINIA	44	
COLUMBUS WELLINGTON	205	
COMPANION EXPRESS	71	
CONCERT EXPRESS	101	
CONTIENTAL WING	137	
CONTSHIP AUSTRALIA	9	
CONTSHIP ENGLAND	20	
CORAH ANN	82	48
CORNUCOPIA	26	47
CORONADO	65	97
CORPUS CHRISTI	122	138
CORWITH CRAMER	10	30
COURIER	41	57
COURTNEY BURTON	113	143
COURTNEY L.	102	186
CPL. LOUIS J. HAUGE JR	9	36
CRISTOFORO COLOMBO	32	12
CSL ATLAS	15	
CSL INNOVATOR	154	
CSS HUDSON	147	
DAN MOORE	2	
DAPHNE	2	
DEL MONTE CONSUMER	33	138
DEL MONTE TRADER	86	17
DELAWARE TRADER	103	52
DELMONTE TRANSPORTER	25	70
DIANA	9	23
DIRECT FALCON	130	199
DIRECT KEA	235	
DIRECT KIWI	60	69
DIRECT KOOKABURRA	126	254
DOCK EXPRESS 20	37	
DOCTOR LYKES	132	43
DOLE CALIFORNIA	49	
DOROTHEE		175
DOUBLE GLORY	47	52
DSR BALTIC	151	
DSR EUROPE	192	
DUSSELDORF EXPRESS	97	
DYVI BALTIC	22	26
DYVI OCEANIC	48	
E.P. LE QUEBECOIS	663	
ECSTASY	137	217
EDGAR B. SPEER	234	250
EDWARD L. RYERSON	147	193
EDWIN H. GOTT	319	154
EDYTH L.	73	83
EIBE OLDENDORFF		92
ELIZABETH LYKES	23	82
ELLEN KNUDSEN	49	40
ELLENSBORG	7	71
EMERALD SEA	44	
EMMA OLDENDORFF	96	
ENCHANTED SEAS	33	70
ENDEAVOR 2	27	
EQUALITY STATE	13	
ESSO PUERTO RICO	2	
EUROPEAN SENATOR	47	
EVER GATHER	9	
EVER GENTLE	6	
EVER GIANT	15	
EVER GLAMOUR	22	10
EVER GLEAMY	8	9
EVER GLORY	8	16
EVER GLOWING	6	11
EVER GOODS	16	68
EVER GRADE	20	
EVER GRAND	5	
EVER GROUP	19	
EVER GROWTH	10	11
EVER GUARD	24	

	RADIO	MAIL
EVER GUEST	4	3
EVER GUIDE	8	
EVER LAUREL	27	
EVER LEVEL	13	13
EXPORT FREEDOM	55	94
EXPORT PATRIOT	40	94
FAIRLIFT	72	
FAIRMAST	82	
FANTASY	20	10
FARLAND	1	
FARNELLA	3	
FAUST	53	59
FEDERAL SKEENA	128	
FERNCROFT	136	54
FESTIVALE	31	29
FETISH	120	98
FIESTA MARINA	14	18
FIR GROVE	42	
FOREST HAWK	2	
FRANCES HAMMER	158	
FRANCES L.	92	142
FRANCOIS DE SALE	12	
FRED G.	60	28
FRED R. WHITE JR	82	115
FREJA ISLANDIA	41	
FREJA SVEA	78	82
FRINES	19	
GALVESTON BAY	124	227
GENEVIEVE LYKES	50	99
GEORGE A. SLOAN	41	42
GEORGE A. STINSON	136	154
GEORGE H. WEYERHAEUSER	57	54
GEORGE SHULTZ		102
GEORGE WASHINGTON BRID	174	64
GERMAN SENATOR	32	
GLOBAL LINK	11	18
GLOBAL SENTINEL	67	
GLORIOUS SPICA	13	
GOLDEN APO	28	
GOLDEN GATE	7	16
GOLDEN GATE BRIDGE	186	
GOLDEN MONARCH	18	
GOLDEN TOPAZ	13	
GREAT LAND	4	
GREAT RIVER	2	
GREEN BAY	24	3
GREEN HARBOUR	39	22
GREEN ISLAND	34	33
GREEN KOBE	33	114
GREEN LAKE	96	130
GREEN MAYA	4	
GREEN RIDGE	52	
GREEN SAIKAI	1	
GREEN SASEBO	58	128
GREEN SUMA	41	57
GREEN SYLVAN	25	
GREEN VALLEY	49	52
GREEN WAVE	50	104
GROWTH RING	75	
GUAYAMA	3	
GULF SPEED	66	
GYPSUM BARON	175	
GYPSUM KING	137	
H. LEE WHITE	113	138
HANDY ACCORD		91
HANJIN BREMEN	16	
HANJIN CHUNGMU	41	
HANJIN ELIZABETH	1	
HANJIN FELIXSTOWE	12	
HANJIN HAMBURG	12	
HANJIN HONG KONG	46	
HANJIN KEELUNG	35	25
HANJIN KOBE	37	19
HANJIN LE HAVRE	5	
HANJIN LONG BEACH	16	9
HANJIN MASAN	8	8
HANJIN NEW YORK	30	
HANJIN OAKLAND	18	2
HANJIN ROTTERDAM	16	
HANJIN SAVANNAH	43	
HANJIN VANCOUVER	13	
HANJIN YOKOHAMA	28	
HANSA LUBECK	281	284
HEIDELBERG EXPRESS	166	
HENRY HUDSON BRIDGE	169	
HERBERT C. JACKSON	40	
HERMENIA	52	84
HETTSTEDT	29	
HIBISCUS	119	211
HIRA II	14	

	RADIO	MAIL
HOEGH CAIRN	26	
HOEGH CLIPPER	18	65
HOEGH DRAKE	16	
HOEGH DUKE	5	
HOEGH DYKE	12	22
HOEGH MERCHANT	16	43
HOEGH MINERVA	21	
HONESTA	28	21
HOWELL LYKES	66	164
HUAL ANGELITA	83	86
HUAL INGRITA	39	
HUAL ROLITA	51	87
HUAL TRAPPER	2	
HUMACAO	84	112
HUMBERGRACHT	51	
HUNG CHOW	748	
HYUNDAI COMMANDER	2	
HYUNDAI CONTINENTAL	33	
HYUNDAI DUKE	37	
HYUNDAI INNOVATOR	1	
IBN AL-ATHEER	8	
IBN AL-MOATAZ	29	
INDEPENDENT ACCORD	230	
INDEPENDENT SPIRIT	159	
INDIAN GOODWILL	1	
INDIAN OCEAN	3	42
INDIANA HARBOR	156	156
INFANTA	122	
INGER	61	69
IOWA TRADER	67	35
ISABELLA	32	
ISLAND PRINCESS	15	
ITB BALTIMORE	112	125
ITB GROTON	94	113
ITB NEW YORK	112	136
ITB PHILADELPHIA	18	12
IVER EXPLORER	2	
IVER EXPRESS	30	
J. DENNIS BONNEY	6	228
J.W. POWELL	55	
JACKSONVILLE	137	137
JAHRE SPIRIT	40	
JALAGOPAL	7	
JALAVIHAR	30	58
JALISCO	40	96
JAMES LYKES	38	12
JAMES R. BARKER	206	215
JAPAN RAINBOW 2	28	23
JAPAN SENATOR	258	
JASMINE	7	
JEAN LYKES	52	90
JEB STUART	15	
JOHN G. MUNSON	263	177
JOHN J. BOLAND	115	108
JOHN LYKES	75	99
JOHN YOUNG		106
JOSEPH H. FRANTZ	262	197
JOSEPH L. BLOCK	43	47
JUBILANT	21	10
JUBILEE	28	28
JULIUS HAMMER	2	3
JUPITER	9	
KAIMOKU	183	96
KAINALU	181	102
KAKUSHIMA	18	23
KANSAS TRADER	16	44
KAREN ANDRIE	55	68
KAUAI	77	
KAYE E. BARKER	157	157
KEBAN		49
KEE LUNG	32	51
KEISHO MARU	50	
KELVIN CHALLENGE	28	
KENAI	85	162
KENNETH E. HILL	64	47
KENNETH T. DERR	81	128
KENTUCKY HIGHWAY	48	
KEYSTONE CANYON	19	40
KEYSTONER	58	116
KINSMAN ENTERPRISE	19	55
KITTANING	18	18
KOLN EXPRESS	115	
KOPER EXPRESS	1	
KRAS	35	
KURE	32	
LA TRINITY		16
LAKE CHARLES	29	64
LAKE GUARDIAN	110	114
LASH ATLANTICO	15	14
LAUST MAERSK	36	58
LAWRENCE H. GIANELLA	11	

	RADIO	MAIL
LEISE MAERSK	1	
LEON	7	
LEONARD J. COWLEY	12	
LEONIA	236	
LERMA	39	
LESLIE LYKES	62	83
LETITIA LYKES	7	16
LIBERTY SEA	55	90
LIBERTY SPIRIT	48	69
LIBERTY STAR	40	49
LIBERTY SUN	37	16
LIBERTY VICTORY	55	207
LIBERTY WAVE	26	47
LION OF CALIFORNIA	14	26
LIRCAY	124	
LNG AQUARIUS	20	143
LNG CAPRICORN	3	
LNG LEO	36	106
LNG TAURUS	33	80
LNG VIRGO	17	32
LOA	29	
LONDON ENTERPRISE	28	
LONGAVI	66	47
LONTUE	24	
LOUISE LYKES	39	89
LOUISIANA	53	156
LT ARGOSY	11	56
LT PRAGATI	15	
LT. ODYSSEY	89	
LUNA MAERSK	26	194
LURLINE	49	115
M. P. GRACE	2	
MAASSLOT	93	
MAASSTROOM	48	
MACKINAC BRIDGE	170	15
MADISON MAERSK	32	62
MAERSK BOGOTA	28	
MAERSK CONSTELLATION	55	45
MAERSK JEDDAH	46	53
MAERSK SANTIAGO	95	164
MAERSK TACOMA	10	
MAGIC	125	35
MAGLEBY MAERSK	35	59
MAJ STEPHEN W PLESS MP	5	23
MAJESTIC MAERSK	2	22
MANILA SUNRISE	39	
MANUKAI	76	187
MANULANI	69	104
MARATHA MAJESTY	27	
MARCHEN MAERSK	7	64
MAREN MAERSK	47	59
MARGARET LYKES	30	60
MARGRETHE MAERSK	38	100
MARIA TOPIC	13	
MARIE MAERSK	58	96
MARIF	27	27
MARINE PRINCESS	11	17
MARINE RELIANCE	18	
MARIT MAERSK	74	39
MARJORIE LYKES	63	109
MARLIN		232
MARY GALE	2	
MATHILDE MAERSK	33	74
MATSONIA	93	194
MAUI	2	13
MAURICE EWING	30	24
MAYA	66	
MAYAGUEZ	27	26
MAYVIEW MAERSK	18	58
MC-KINNEY MAERSK	54	113
MEDALLION	117	96
MEDUSA CHALLENGER	347	383
MELBOURNE STAR	126	
MELVILLE	133	123
MERCANDIAN CONTINENT	40	45
MERCHANT PRELUDE	35	
MERCHANT PREMIER	17	
MERCHANT PRINCIPAL	63	
MERCURY ACE	28	
MERIDA	89	120
MESABI MINER	148	117
METTE MAERSK	45	78
MICHIGAN	261	260
MICHIGAN HIGHWAY	29	
MICRONESIAN COMMERCE	13	
MICRONESIAN INDEPENDEN	30	
MICRONESIAN PRIDE	177	
MIDDLETOWN	92	109
MINERVA	1	
MING PEACE	40	
MING PLENTY	35	39

	RADIO	MAIL
MING PROMINENCE	16	
MING PROMOTION	9	
MING PROSPERITY	7	
MITLA	155	24
MIXTECO	98	
MOANA PACIFIC	153	
MOANA WAVE	10	
MOKU PAHU	136	145
MONTERREY	170	123
MORELOS	166	74
MORMACSKY	15	
MORMACSTAR	59	110
MORMACSUN	56	25
MT. CABRIT	3	
MYRON C. TAYLOR	122	131
MYSTIC	77	
NACIONAL SANTOS	3	
NARA	42	
NATIONAL DIGNITY	31	42
NATIONAL HONOR	26	80
NATIONAL PRIDE	8	14
NCC ARAR	4	5
NEDLLOYD HOLLAND	51	112
NEDLLOYD MAAS	10	
NEDLLOYD MADRAS	1	
NEDLLOYD MANILA	3	
NEDLLOYD MARSEILLS	50	
NEDLLOYD ROTTERDAM	130	
NEDLLOYD TOKYO	36	
NEDLLOYD VAN CLOON	118	
NEDLLOYD VAN DIEMEN	125	
NEDLLOYD VAN LINSCHOTE	67	
NEDLLOYD VAN NOORT	144	
NEPTUNE ACE	47	
NEPTUNE AMBER	5	
NEPTUNE AZURITE	22	
NEPTUNE CORAL	4	
NEPTUNE CRYSTAL	30	
NEPTUNE DIAMOND	126	
NEPTUNE GARNET	42	
NEPTUNE JADE	34	
NEPTUNE PEARL	31	
NEW HORIZON	30	24
NEW YORK SENATOR	29	
NEWARK BAY	60	67
NIEUW AMSTERDAM	4	
NIPPON HIGHWAY	4	
NOAA DAVID STARR JORDA	134	117
NOAA SHIP CHAPMAN	142	144
NOAA SHIP DELAWARE II	298	463
NOAA SHIP DISCOVERER O	481	497
NOAA SHIP FERREL	15	34
NOAA SHIP M. BALDRIDGE	344	166
NOAA SHIP MCARTHUR	315	417
NOAA SHIP MILLER FREEM	401	466
NOAA SHIP MT MITCHELL	139	499
NOAA SHIP OREGON II	496	353
NOAA SHIP RAINIER	241	
NOAA SHIP SURVEYOR	186	270
NOAA SHIP T. CROMWELL	12	194
NOAA SHIP WHITING	372	140
NOBEL STAR	186	59
NORTHERN LIGHTS	217	237
NORWAY	36	23
NOSAC FOREST	152	
NOSAC RANGER	32	98
NOSAC ROVER		12
NOSAC TAKAYAMA	9	171
NOVA EUROPA	1	
NUEVO SAN JUAN	59	132
NURNBERG ATLANTIC	194	
NYK SPRINGTIDE	59	
NYK STARLIGHT	72	
NYK SURFWIND	40	
OAXACA	148	
OBO ENGIN	12	
OCEAN BRIDGE	46	
OCEAN CHEER	51	
OCEAN CITY	70	77
OCEAN HIGHWAY	19	
OCEAN SPIRIT	372	
OCEAN VICTOR	21	21
ODELIA	31	46
OLEANDER	140	97
OLIVE ACE	34	22
OMI CHARGER	31	53
OMI DYNACHEM	4	
OMI MISSOURI	64	23
OMI WABASH	14	
OMI WILLAMETTE	55	76
OOCL BRAVERY	74	

	RADIO	MAIL
OOCL EDUCATOR	51	
OOCL ENVOY	89	48
OOCL EXECUTIVE	37	
OOCL EXPLORER	133	147
OOCL EXPORTER	83	
OOCL FAIR	119	56
OOCL FAITH	86	
OOCL FAME	31	
OOCL FIDELITY	112	24
OOCL FORTUNE	162	
OOCL FREEDOM	60	
OOCL FRIENDSHIP	58	
OOCL INNOVATION	58	112
OOCL INSPIRATION	92	119
ORANGE BLOSSOM	18	97
ORANGE STAR	19	148
ORCHID	28	14
OREGON RAINBOW II	57	94
OREGON STAR	191	
ORION HIGHWAY	141	78
OURO DO BRASIL	24	122
OVERSEAS ARCTIC	40	21
OVERSEAS CHICAGO	15	54
OVERSEAS HARRIET	49	
OVERSEAS JOYCE	81	
OVERSEAS JUNEAU	8	55
OVERSEAS MARILYN	20	15
OVERSEAS NEW ORLEANS	50	66
OVERSEAS NEW YORK	42	196
OVERSEAS OHIO	38	107
OVERSEAS PHILADELPHIA		123
PACASIA	28	
PACDUKE	1	
PACIFIC EMERALD	70	92
PACIFIC PRINCESS	73	
PACKING	9	
PACMERCHANT	27	
PACOCEAN	51	
PACPRINCE	31	
PACPRINCESS	40	12
PACQUEEN	28	19
PACSEA	12	
PACSTAR	15	
PAPAGO	52	
PARIS SENATOR	8	
PATRIOT	33	41
PAUL BUCK	51	
PAUL H. TOWNSEND	141	160
PAUL R. TREGURTHA	367	384
PAUL THAYER	4	
PC EXPLORER	11	50
PECOS	23	25
PETER W. ANDERSON	38	18
PETROBULK PROGRESS	107	
PFC DEWAYNE T. WILLIAM	2	
PFC EUGENE A. OBREGON	5	12
PFC JAMES ANDERSON JR	29	49
PFC WILLIAM B. BAUGH	18	29
PHAROS	97	
PHILIP R. CLARKE	134	152
PHOENIX DIAMOND	3	
PIERRE FORTIN	470	
PISCES PLANTER	56	
PLATTE	29	35
POLAR ALASKA	32	92
POLYNESIA	103	63
POTOMAC	28	20
POTOMAC TRADER	2	
PRESIDENT ADAMS	60	146
PRESIDENT ARTHUR	67	197
PRESIDENT BUCHANAN	23	52
PRESIDENT EISENHOWER	121	155
PRESIDENT F. ROOSEVELT	161	126
PRESIDENT GARFIELD	14	
PRESIDENT GRANT	70	132
PRESIDENT HARDING	57	10
PRESIDENT HARRISON	110	
PRESIDENT HOOVER	37	48
PRESIDENT JACKSON	118	168
PRESIDENT JEFFERSON	50	143
PRESIDENT KENNEDY	125	147
PRESIDENT LINCOLN	143	228
PRESIDENT MONROE	133	184
PRESIDENT POLK	157	189
PRESIDENT TRUMAN	50	78
PRESIDENT TYLER	68	214
PRESIDENT WASHINGTON	192	181
PRESQUE ISLE	306	352
PRIDE OF BALTIMORE	35	58
PRINCE OF OCEAN	117	214
PRINCE OF TOKYO	105	229

	RADIO	MAIL
PRINCE OF TOKYO 2	101	197
PRINCE WILLIAM SOUND	7	12
PROFESOR MIERZEJEWSKI	3	
PUERTO CORTES	17	
PVT FRANKLIN J. PHILLI	15	35
PYTCHLEY	168	
QUEEN ELIZABETH 2	178	
QUEENSLAND STAR	168	
R. HAL DEAN	29	34
R.J. PFEIFFER	151	119
RAINBOW HOPE	172	133
RAINBOW WARRIOR	12	
RALEIGH BAY	53	124
RANGER III	59	48
RANI PADMINI	58	
RECIFE	250	383
REPULSE BAY	48	
RESERVE	138	143
RESOLUTE	38	51
RHINE FOREST	37	78
RICHARD G MATTIESEN	28	40
RICHARD REISS	21	13
RIVERHEAD SPIRIT	41	62
ROBERT E. LEE	12	26
ROGER BLOUGH	90	62
ROSETTA	18	
ROSINA TOPIC	26	3
ROVER	31	28
ROWANBANK	89	
ROYAL PRINCESS	76	
RUBIN DOGA	28	
RUBIN OCEAN	40	67
RUBIN U		13
RUTH LYKES	39	71
S.T. CRAPO	291	182
SALINA CRUZ PILOTS	234	47
SALINAS	9	23
SAM HOUSTON	35	38
SAMUAL GINN	18	
SAMUEL H. ARMACOST	102	124
SAMUEL L. COBB	40	17
SAMUEL RISLEY	45	
SAN LUIS	85	
SAN MARCOS	56	72
SAN MARTIN	72	
SAN PEDRO	50	
SANTA BARBARA	180	
SANTA FE DE BOGOTA	20	
SANTA MONICA	44	
SANTA PAULA	107	111
SANTORIN 2	63	322
SAPAI	1	
SATURN DIAMOND	11	
SAVANNAH	64	
SCARAB	26	
SEA BELLS	12	161
SEA COMMERCE	156	
SEA FAN	37	122
SEA FORTUNE	6	
SEA FOX	72	7
SEA ISLE_CITY	38	79
SEA LIGHT	18	40
SEA LION	321	128
SEA MERCHANT	239	271
SEA SPRAY	1	
SEA TRADE	5	
SEA WOLF	211	96
SEA-LAND SHINING STAR	69	63
SEABOARD HORIZON	1	
SEABOARD OCEAN	95	114
SEABOARD SUN	37	42
SEALAND ACHIEVER	126	138
SEALAND ANCHORAGE	67	69
SEALAND ATLANTIC	51	91
SEALAND CHALLENGER	78	115
SEALAND CONSUMER	201	143
SEALAND CRUSADER	91	98
SEALAND DEFENDER	32	62
SEALAND DEVELOPER	71	106
SEALAND DISCOVERY	84	57
SEALAND ENDURANCE	57	120
SEALAND ENTERPRISE	209	160
SEALAND EXPEDITION	61	80
SEALAND EXPLORER	74	117
SEALAND EXPRESS	179	175
SEALAND HAWAII	224	229
SEALAND INDEPENDENCE	57	129
SEALAND INNOVATOR	95	91
SEALAND INTEGRITY	185	255
SEALAND KODIAK	29	12
SEALAND LIBERATOR	66	96

	RADIO	MAIL
SEALAND MARINER	57	77
SEALAND NAVIGATOR	233	259
SEALAND PACIFIC	196	161
SEALAND PATRIOT	65	94
SEALAND PERFORMANCE	76	126
SEALAND PRODUCER	97	123
SEALAND QUALITY	48	35
SEALAND RELIANCE	102	219
SEALAND SPIRIT	82	253
SEALAND TACOMA	39	
SEALAND TRADER	217	236
SEALAND VALUE	69	117
SEALAND VOYAGER	78	88
SEARIVER BATON ROUGE	19	6
SEARIVER BENICIA	32	15
SEARIVER CHARLESTOWN	2	
SEARIVER NEW ORLEANS	17	23
SEARIVER NORTH SLOPE	23	
SEARIVER PHILADELPHIA	2	
SEARIVER SAN FRANCISCO	26	52
SEAWARD JOHNSON	150	173
SEDCO/BP 471	83	183
SENATOR	101	41
SEVEN OCEAN		6
SGT WILLIAM A BUTTON	1	
SHELDON LYKES	59	124
SHELLY BAY	105	112
SHIRAOI MARU	145	39
SHOWA MARU	16	
SIDNEY STAR	224	
SINCERE GEMINI	13	31
SINCERE SUCCESS	15	
SKANDERBORG	14	11
SKAUBRYN	48	
SKAUGRAN	141	144
SKAUKAR	47	36
SKODSBORG	11	11
SN	11	
SOKOLICA	25	25
SOLAR WING	69	109
SONORA	79	133
SOUTHLAND STAR	111	
SPRING BEE	1	
ST BLAIZE	67	
ST. CLAIR	162	211
ST. LUCIA	35	
STAFFORDSHIRE	117	
STAR ALABAMA	38	29
STAR AMERICA	17	28
STAR DRIVANGER	101	
STAR DROTTANGER	109	
STAR EAGLE	95	116
STAR EVVIVA	64	42
STAR FLORIDA	104	128
STAR FRASER	74	102
STAR FUJI	30	
STAR GEIRANGER	14	32
STAR GRAN	78	90
STAR MASSACHUSETTS	2	
STAR SKOGANGER	23	45
STAR STRONEN		35
STAR WESTCHESTER	28	
STAR WILMINGTON	35	
STELLA LYKES	30	78
STENA TRANSFER	178	274
STEWART J. CORT	447	488
STOLT CONDOR	10	
STOLT HAWK	2	
STONEWALL JACKSON	12	4
STRIDER ISIS	27	
STRIDER JUNO	33	
STRONG ICELANDER	95	91
STRONG VIRGINIAN	36	46
SUE LYKES	53	74
SUGAR ISLANDER	21	
SUNBELT DIXIE	42	50
SUNRISE	42	
SUNRISE RUBY	46	68
SYNNOVE KNUSTEN	74	
T.S.EMPIRE STATE	12	33
T.S.S. FIESTA MARINA	109	52
TABASCO	109	35
TABUK	66	78
TAI CHUNG	145	71
TAI HE	48	
TAI SHAN	28	35
TAI SHING	33	72
TAMPA	27	
TAMPA BAY	23	39
TARGA	2	
TEXAS CLIPPER	11	
TEXAS TRADER	6	

	RADIO	MAIL
THOMAS G. THOMPSON	192	
THOMPSON LYKES	60	94
THOMPSON PASS	2	35
TILLIE LYKES	41	60
TOBA	29	
TOKAI MARU	18	
TOKYO HIGHWAY	39	
TOLUCA	160	146
TONCI TOPIC	6	
TONSINA	64	49
TORM FREYA	107	32
TOWER BRIDGE	87	
TRANSWORLD BRIDGE	142	84
TRICORD SUCCESS	14	2
TRIGGER	42	
TRITON	230	298
TROPIC DAY		50
TROPIC FLYER		19
TROPIC ISLE		24
TROPIC JADE		28
TROPIC KEY		81
TROPIC LURE		58
TROPIC MIST		16
TROPIC NIGHT		34
TROPIC OPAL		21
TROPIC REIGN		23
TROPIC SUN	6	
TROPIC TIDE	6	
TROPICAL BEAUTY		127
TROPICALE	17	13
TSL BOLD	70	289
TULSIDAS	16	
TYSON LYKES	25	24
UCHOA	59	112
ULLSWATER	215	
ULTRAMAX	29	18
ULTRASEA	23	
UNIVERSE	31	
USCGC ACACIA (WLB406)	16	23
USCGC ACTIVE WMEC 618	39	
USCGC ACUSHNET WMEC 16	22	
USCGC BASSWOOD (WLB 38	15	
USCGC BEAR (WEMC 901)	25	
USCGC BOUTWELL WHEC 71	64	
USCGC BRAMBLE (WLB 392	7	
USCGC CAMPBELL	72	
USCGC CHASE (WHEC 718)	58	
USCGC CITRUS (WMEC 300	79	108
USCGC CONFIDENCE WMEC6		43
USCGC COURAGEOUS	13	32
USCGC DECISIVE WMEC 62	6	
USCGC DEPENDABLE	30	
USCGC DURABLE (WMEC 62	74	
USCGC EAGLE (WIX 327)	49	92
USCGC ESCANABA	11	
USCGC ESCAPE (WMEC 6)	28	
USCGC FIREBUSH WLB 393	16	
USCGC FORWARD	40	23
USCGC HAMILTON WHEC 71	191	78
USCGC HARRIET LANE	36	
USCGC IRONWOOD (WLB 29	13	
USCGC JARVIS (WHEC 725	111	
USCGC LEGARE	35	
USCGC MACKINAW	36	58
USCGC MALLOW (WLB 396)	56	16
USCGC MARIPOSA	21	
USCGC MELLON (WHEC 717	63	39
USCGC MIDGETT (WHEC 72	77	
USCGC MOHAWK WMEC 913	36	
USCGC MORGENTHAU	63	
USCGC MUNRO	59	
USCGC NORTHLAND WMEC 9	30	36
USCGC PLANETREE	30	
USCGC POLAR SEA__(WAGB	332	328
USCGC POLAR STAR (WAGB	445	407
USCGC RESOLUTE WMEC 62	67	
USCGC RUSH	73	73
USCGC SASSAFRAS	29	
USCGC SEDGE (WLB 402)	6	
USCGC SENECA	64	85
USCGC SPENCER	87	182
USCGC STORIS (WMEC 38)	42	
USCGC SUNDEW (WLB 404)	4	
USCGC SWEETBRIER WLB 4	11	
USCGC TAHOMA	6	
USCGC TAMAROA (WMEC 16	3	
USCGC TAMPA WMEC 902	51	29
USCGC VENTUROUS WMEC 6	1	
USCGC VIGILANT WMEC 61	15	
USCGC YOCONA (WMEC 168	25	
USNS ALGOL	10	

	RADIO	MAIL
USNS ANTARES		46
USNS APACHE (T-ATF 172	106	
USNS BELLATRIX	2	23
USNS CATAWBA T-ATF 168	43	70
USNS CONCORD		189
USNS GUS W. DARNELL	69	48
USNS HAYES	43	
USNS HENRY J. KAISER		13
USNS JOHN ERICSSON	2	
USNS KANAWHA T-AO 196		75
USNS KANE TAGS 27	67	66
USNS LITTLEHALES (T-AG	152	245
USNS MAURY	2	
USNS MOHAWK (T-ATF 170	21	51
USNS NARRAGANSETT	55	8
USNS NAVAJO_(TATF-169)	79	
USNS PECOS	27	
USNS POWHATAN TATF 166	45	
USNS REGULUS	19	
USNS SEALIFT ANTARCTIC		67
USNS SEALIFT ARABIAN S	55	
USNS SEALIFT ARCTIC	34	
USNS SEALIFT ATLANTIC	78	42
USNS SEALIFT CHINA SEA	16	
USNS SEALIFT MEDITERRA	92	76
USNS SEALIFT PACIFIC		15
USNS SIOUX	103	68
USNS VANGUARD TAG 194	33	
USNS VICTORIOUS	28	
USNS WILKES T-AGS-33	101	73
VAN TRADER	21	
VEGA	45	
VELMA LYKES	52	58
VENUS DIAMOND	20	
VERA ACORDE	46	
VINE	128	
VIRGINIA	15	62
VISHVA SHAKTI	4	
VISHVA VIKRAM	2	
VIVA	19	95
WASHINGTON RAINBOW #2	21	
WECOMA	170	167
WELLINGTON STAR	46	
WEST MOOR	190	
WESTERN GALLANTRY	34	
WESTWARD	5	
WESTWARD VENTURE	60	143
WESTWOOD ANETTE	78	125
WESTWOOD BELINDA	37	24
WESTWOOD CLEO	102	
WESTWOOD JAGO	124	135
WESTWOOD MARIANNE	47	151
WILFRED SYKES	147	169
WOLVERINE	47	53
WORLD WING #2	66	61
YAMANAKA MARU	91	
YOUNG SPROUT	92	91
ZETLAND	227	
ZIM AMERICA	103	
ZIM CANADA	56	
ZIM HOUSTON	5	
ZIM IBERIA	88	
ZIM KEELUNG	97	
ZIM MIAMI	25	
ZIM SAVANNAH	80	

SUMMARY: GRAND TOTAL VIA RADIO
68980

GRAND TOTAL VIA MAIL
54016

TOTAL UNIQUE OBS
92287

TOTAL DUPLICATES
30709 (33.3%)

UNIQUE RADIO OBS.
38271 (41.5%)

UNIQUE MAIL OBS.
23307 (25.3%)

Bathy–Tesac Data at NMC

July, August and September 1993

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
BOAB	34	34	0	TAI HE
CGDG	13	0	13	HUDSON
CG2676	90	19	71	SHAMOOK
CG2683	323	218	105	ALFRED NEEDLER
CG2965	4	4	0	W.E. RICKER
CTFK	1	1	0	ALVARES CABRAL
CZDO	23	23	0	QUEST
C6JY6	60	60	0	MELBOURNE STAR
C6JZ2	120	120	0	AMERICA STAR
DAKE	96	96	0	KOELN ATLANTIC
DBBX	217	111	106	GAUSS
DBFP	20	20	0	WALTHER HERWIG
DD8436	3	3	0	FEHMARNBELT
DGLM	102	102	0	MONTE ROSA
DGVK	98	98	0	COLUMBUS VICTORIA
DHCM	66	66	0	***
DHCW	88	88	0	COLUMBUS WELLINGTON
DIDA	67	67	0	ARIANA
DLEZ	8	8	0	YANKEE CLIPPER
D5BC	17	17	0	SEDCO BP/471
D5ND	126	126	0	SAINT LUCIA
D5NE	86	86	0	MT CABRITE
D5NZ	52	52	0	POLYNESIA
ELAX2	33	33	0	MICRONESIAN PRIDE
ELBX3	9	9	0	PACKING
ELEH4	48	48	0	DELMAS TOURVILLE
ELIL9	77	77	0	T A NAVIGATOR
ELIS8	86	86	0	T A MARINER
ELOF6	6	6	0	LONGAVI
ERES	25	21	4	VICTOR BUGAEN
FHQB	48	48	0	***
FNDK	45	45	0	PATRICIA DELMAS
FNOM	11	11	0	RENOIR
FNQC	29	29	0	RENEE DELMAS
FNQM	76	76	0	SUZANNE DELMAS
FNWC	40	40	0	NATHALIE DELMAS
FNXM	3	3	0	***
FNXN	21	21	0	***
FNXW	20	20	0	SAINT ROCH
FNZO	5	5	0	RIMBAUD
FNZP	18	18	0	RACINE
FNZQ	19	19	0	RIMBAUD
FWQP	11	11	0	A. NIZERY
GACA	153	153	0	CUMULUS
GYRW	37	37	0	ENCOUNTER BAY
GYSA	35	35	0	FLINDERS BAY
GYSE	30	30	0	NEDLLOYD TASMAN
HPAN	37	37	0	MICRONESIAN COMM.
HPEW	110	110	0	PACIFIC ISLANDER
H9BQ	68	68	0	MICRONESIAN INDEP.
JBOA	47	47	0	KEIFU MARU
JCCX	73	73	0	CHOFU MARU
JCOD	20	20	0	SHOYO
JDWX	57	57	0	KOFU MARU
JFDG	66	66	0	SHUMPU MARU
JFPQ	150	150	0	KASHIMASAN MARU
JGZK	46	46	0	RYOFU MARU
JITV	127	127	0	WELLINGTON MARU
JIVB	72	72	0	SEIFU MARU
JJRQ	1	1	0	***

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
JKCF	46	46	0	GEORGE WASHINGTON BR
J8GG4	51	51	0	HORIZON
KGJB	24	24	0	SEALAND DEFENDER
KIRH	101	101	0	SEALAND TRADER
KNBD	7	7	0	DELAWARE II
KNFG	110	110	0	SEA WOLF
KRGB	102	102	0	SEALAND ENTERPRISE
KVWA	6	6	0	TEXAS CLIPPER
LADB2	37	37	0	SKAUGRAN
LAJV4	36	36	0	SKAUBRYN
LOAG	2	2	0	***
LOAM	2	2	0	***
LOFA	25	0	25	***
LQHS	1	1	0	***
LRGS	17	0	17	***
NAVOCE	165	165	0	U.S. NAVAL OCEANOGRAPHIC
NBTM	16	16	0	POLAR STAR
NCSG	20	20	0	***
NIKA	13	13	0	SEALIFT ATLANTIC
NJHD	2	2	0	DOYLE
NNJB	14	14	0	***
NNUD	122	122	0	SILAS BENT
NOPQ	3	3	0	THORN
NRUO	67	67	0	POLAR SEA
NZSK	43	43	0	E. KANE
N900AM	49	49	0	AIRCRAFT
OWUO6	80	80	0	MOANA PACIFIC
PGEC	67	67	0	NEDLLOYD VAN NOORT
PGFE	67	67	0	NEDLLOYD VAN DIEMEN
PJJU	32	32	0	OLEANDER
PURPLE	32	32	0	***
P3BN3	1	1	0	***
P3LK3	55	55	0	***
SCOU	2	2	0	TV 243
SCPC	1	1	0	***
SCPI	4	4	0	TV 258
SEXN	4	4	0	TV 227
SEXQ	1	1	0	TV 278
SEXU	1	1	0	TV 04
SEYD	2	2	0	TV 274
SHIP	840	840	0	***
SHPF	2	2	0	TV 281
SKVP	5	5	0	TV 284
SMZQ	1	1	0	TV 102
S6FK	115	115	0	SWAN REEFER
TFEA	45	45	0	BJARNI SAEMUNDSSIN
TFJA	57	57	0	ARNI FRIDRIKSSON
TFVD	28	28	0	***
TWR3	1	1	0	***
UFJN	28	0	28	VILNYUS
UQHM	34	0	34	ABAKANLES
VC9450	44	9	35	GADUS ATLANTICA
VJBQ	29	29	0	ANRO AUSTRALIA
VJDI	82	82	0	IRON NEWCASTLE
VJDP	99	99	0	IRON PACIFIC
VKCN	85	85	0	CANBERRA
VKCV	104	104	0	DERWENT
VKDA	8	8	0	DARWIN
VKLA	99	99	0	ADELAIDE
VKLP	1	1	0	HMAS MELBOURNE
VKMK	77	77	0	SWAN

Bathy–Tesac Data at NMC

July, August and September 1993

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
VKML	71	71	0	SYDNEY
VKPT	31	31	0	PERTH
VLNB	64	64	0	TORRENS
VQ2T	19	10	9	***
VSBI3	48	48	0	BIBI
VXN8	441	441	0	AIRCRAFT
VXZM	85	0	85	***
WPGK	120	120	0	SEALAND NAVIGATOR
WPKD	126	126	0	SEALAND ACHIEVER
WRBA	2	2	0	PACMISRAN HAWAII
WRBB	3	3	0	PACIFIC MISSLE RANGE
WSRL	104	104	0	SEALAND PACIFIC
WTDF	2	2	0	TOWNSEND CROMWELL
WTDK	76	43	33	D.S. JORDAN
WTDM	1	1	0	MILLER FREEMAN
WTDO	7	0	7	OREGON II
WTEA	46	2	44	DISCOVER
WTEJ	39	39	0	MCARTHUR
WTES	1	1	0	SURVEYOR
WXBR	12	12	0	CHEVRON MISSISSIPPI
YDLR	86	86	0	BOGASARI LIMA
Y3CH	12	0	12	PROF. ALBRECHT PENK
ZCAQ9	205	205	0	WEST MOOR
ZCKP	26	26	0	STAR DRIVANGER
ZCKU	23	23	0	STAR DROTTANGER
ZDAZ6	96	96	0	T A EXPLORER
ZMFS	2	2	0	WELLINGTON
3EET4	1	1	0	SEAS EIFFEL
3EFY6	55	55	0	***
3EGR6	37	37	0	RECIFE
3EHE6	17	17	0	***
3EHT6	22	22	0	KARINA BONITA
7JOB	9	9	0	CALIFORNIA CERES
7KDD	5	5	0	YOKO MARU
9VBZ	43	43	0	MAHSURI
9VUU	44	44	0	ANRO ASIA
9VVB	107	107	0	GOLDENSARI INDAH
9VWM	51	51	0	NEW ZEALAND STAR
21002	651	651	0	BUOY
21004	719	719	0	BUOY
22001	723	723	0	BUOY
23001	53	53	0	BUOY
25123	1	1	0	BUOY
25124	1	1	0	BUOY
25126	1	1	0	BUOY
25136	1	1	0	BUOY
32315	80	80	0	BUOY
32316	77	77	0	BUOY
32317	80	80	0	BUOY
32318	83	83	0	BUOY
32319	82	82	0	BUOY
32320	53	53	0	BUOY
32321	67	67	0	BUOY
32322	79	79	0	BUOY
43001	76	76	0	BUOY
51006	79	79	0	BUOY
51008	77	77	0	BUOY
51009	78	78	0	BUOY
51010	83	83	0	BUOY
51011	82	82	0	BUOY

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
51014	77	77	0	BUOY
51015	70	70	0	BUOY
51016	80	80	0	BUOY
51017	15	15	0	BUOY
51018	82	82	0	BUOY
51019	85	85	0	BUOY
51020	81	81	0	BUOY
51021	82	82	0	BUOY
51022	236	236	0	BUOY
51023	84	84	0	BUOY
51301	64	64	0	BUOY
51302	78	78	0	BUOY
51303	80	80	0	BUOY
51304	76	76	0	BUOY
51305	78	78	0	BUOY
51306	78	78	0	BUOY
51307	83	83	0	BUOY
51308	65	65	0	BUOY
51309	79	79	0	BUOY
51310	21	21	0	BUOY
52001	83	83	0	BUOY
52002	81	81	0	BUOY
52003	81	81	0	BUOY
52004	85	85	0	BUOY
52006	82	82	0	BUOY
52007	77	77	0	BUOY
52008	77	77	0	BUOY
52011	81	81	0	BUOY
52012	76	76	0	BUOY
52302	81	81	0	BUOY
52306	82	82	0	BUOY
52307	82	82	0	BUOY
52309	75	75	0	BUOY
52310	78	78	0	BUOY
52311	82	82	0	BUOY
52312	75	75	0	BUOY
52313	83	83	0	BUOY
52314	79	79	0	BUOY

TOTAL BATHYS RECEIVED 14458
TOTAL TESACS RECEIVED 628
TOTAL REPORTS RECEIVED 15086

July, August and September 1993

Wave observations are taken each hour during a 20-minute averaging period, with a sample taken every 0.67 seconds. The significant wave height is defined as the average height of the highest one-third of the waves during the average period each hour. The maximum significant wave height is the highest of those values for that month. At most stations, air temperature, water temperature, wind speed and direction are sampled once per second during an 8.0-minute averaging period each hour (moored buoys) and a 2.0-minute averaging period for fixed stations (C-MAN). Contact NDBC Data Systems Division, Bldg 1100, SSC, Mississippi 39529 or phone (601) 688-2838 for more details.

BUOY JULY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
32302	18.0S	085.1W	0742	18.3	19.6	2.7	4.1	06/10	15.8	SE	26.2	06/10	1017.4
41001	34.7N	072.7W	0740	26.2	26.6	1.1	2.2	20/16	9.5	SW	21.4	20/15	1016.4
41002	32.3N	075.2W	0696	26.9	27.3	1.0	2.1	17/10	9.3	SW	20.8	17/09	1016.9
41004	32.5N	079.1W	0380	28.5	29.1	0.6	1.4	16/06	8.9	SW	20.0	16/05	1014.5
41006	29.3N	077.4W	0742	27.9	28.5	0.8	1.5	13/16	8.1	SW	21.2	06/16	1017.6
41009	28.5N	080.2W	1478	27.7	28.2	0.4	1.0	17/04	7.9	S	20.0	31/22	1017.4
41010	28.9N	078.5W	1481	28.2	28.4	0.7	1.5	31/23	7.5	S	23.3	31/22	1017.8
41015	35.4N	075.3W	0569	26.6	26.3	0.7	1.5	20/05	8.2	SW	18.5	20/03	1016.4
41016	24.6N	076.5W	0741	28.3	29.2	0.4	1.2	25/14	8.8	E	24.2	25/18	1017.9
41017	35.4N	075.1W	0563	26.8	26.9	0.7	1.6	15/03	9.1	SW	19.2	15/05	1016.3
42001	25.9N	089.7W	0742	28.6	29.6	0.3	1.1	05/13	7.3	E	18.1	05/06	1017.4
42002	25.9N	093.6W	0743	28.6	29.2	0.7	1.9	05/14	10.0	SE	20.6	05/07	1016.4
42003	25.9N	085.9W	0742	28.8	29.6	0.4	1.1	26/02	6.8	E	18.8	31/16	1017.8
42007	30.1N	088.8W	0527	28.2	29.8				8.5	SW	23.9	21/21	1017.0
42019	27.9N	095.0W	0744	29.9	29.0	1.0	2.2	05/06	10.7	S	21.0	05/05	1015.9
42020	27.0N	096.5W	0180	28.2	28.4	1.6	2.3	05/07	17.1	SE	22.0	05/05	1014.1
42035	29.2N	094.4W	0342	28.4	28.9	0.9	1.8	05/10	12.2	S	20.2	05/11	1015.9
44004	38.5N	070.7W	0743	23.6	23.5	1.0	4.4	20/16	9.2	SW	30.1	20/12	1014.9
44005	42.6N	068.6W	0741	17.5	16.6	0.9	2.9	20/18	9.1	S	26.4	20/16	1013.3
44007	43.5N	070.1W	0741	17.9	15.7	0.5	1.9	20/18	7.7	S	22.7	16/23	1013.4
44008	40.5N	069.4W	0742	18.2	15.6	0.8	3.3	21/00	9.7	W	26.8	20/12	1014.3
44009	38.5N	074.7W	0740	24.2	23.8	0.6	1.9	20/01	8.5	S	26.0	20/03	1015.1
44011	41.1N	066.6W	0743	15.5	13.8	1.0	3.5	21/01	8.5	SW	24.9	31/02	1014.1
44013	42.4N	070.8W	0733	20.1	17.3	0.3	1.5	20/14	9.3	SW	22.7	16/23	1013.7
44014	36.6N	074.8W	0742	25.9	26.0	0.5	1.6	20/02	8.2	SW	21.8	30/05	1015.1
44025	40.3N	073.2W	0740	22.6	22.0	0.7	2.4	20/02	9.8	SW	26.6	19/23	1013.9
45001	48.1N	087.8W	0742	7.3	4.3	0.5	1.7	04/18	8.7	SE	22.9	31/12	1013.7
45002	45.3N	086.4W	0741	17.5	16.8	0.6	2.4	05/21	9.2	S	24.7	29/21	1013.6
45003	45.3N	082.7W	0741	14.9	13.0	0.6	2.3	29/18	9.0	NW	26.2	29/18	1013.8
45004	47.5N	086.5W	0591	7.1	4.1	0.4	1.7	04/21	8.1	W	22.7	04/16	1014.5
45005	41.7N	082.4W	0743	23.2	23.5	0.4	1.5	01/04	9.0	W	23.3	29/21	1015.0
45006	47.3N	089.9W	0742	9.9	5.8	0.5	1.8	26/11	7.2	SW	17.4	26/16	1012.7
45007	42.8N	087.1W	0741	19.3	18.2	0.4	1.7	29/13	8.9	S	20.6	29/11	1014.0
45008	44.3N	082.4W	0739	18.9	18.0	0.6	2.5	30/04	8.2	NW	20.4	30/08	1014.5
45010	43.0N	087.8W	0738	18.8	16.7	0.3	1.1	30/09	7.5	SE	24.3	06/01	1014.0
46001	56.3N	148.2W	0740	11.7	12.1	1.7	3.6	02/13	11.8	W	23.7	02/09	1019.6
46002	42.5N	130.3W	0733	14.8	15.3	1.9	3.6	07/15	13.9	N	23.7	07/04	1023.2
46005	46.1N	131.0W	0069	14.9	15.2	1.7	2.5	29/09	11.4	S	17.5	30/06	1018.9
46006	40.9N	137.5W	0739	15.5	15.9	1.6	3.2	22/17	11.4	NE	19.8	07/05	1027.9
46013	38.2N	123.3W	0736	11.6	10.5	2.3	3.9	13/04	14.0	NW	30.7	14/02	1013.1
46014	39.2N	124.0W	0735	12.0	10.8	2.3	4.2	12/23	14.2	NW	30.3	13/00	1014.7
46022	40.8N	124.5W	0738	12.5	11.8	2.2	4.9	07/05	9.3	N	24.9	24/20	1017.0
46023	34.3N	120.7W	0735	15.5	16.9	2.0	3.7	16/07	12.4	NW	26.4	22/02	1013.8
46025	33.8N	119.1W	0743	18.4	20.4	1.0	1.6	22/03	6.5	W	14.0	16/01	1013.5
46026	37.8N	122.7W	0734	12.6	12.6	1.6	2.5	02/04	12.2	NW	31.5	03/00	1013.9
46028	35.8N	121.9W	0740	14.1	16.6	2.3	3.7	16/10	11.8	NW	29.7	23/04	1014.4
46029	46.2N	124.2W	0740	15.2	14.9	1.5	3.0	06/18	7.6	NW	18.3	22/06	1019.3
46030	40.4N	124.5W	0740	11.1	9.2	1.8	3.9	25/04	12.1	N	20.4	07/11	1016.6
46035	57.0N	177.7W	0701	8.1	8.0	1.3	3.7	20/13	12.7	SE	26.4	20/06	1014.6
46041	47.4N	124.5W	0728	13.7	14.2	1.4	2.8	05/13	6.7	NW	17.7	22/03	1018.8

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
46042	36.8N	122.4W	0732	13.3		2.1	3.4	24/14	10.3	NW	23.5	17/00	1014.8
46045	33.8N	118.5W	0738	19.1	20.5	0.5	1.1	09/23	6.5	W	13.4	29/22	1013.0
46047	32.7N	119.6W	0739	16.5	17.7	1.9	3.4	16/10	9.4	NW	25.3	21/07	1014.4
46048	32.9N	117.9W	0740	18.7	20.1	1.0	1.7	09/22	6.8	W	15.7	08/01	1013.2
46050	44.6N	124.5W	0733	15.1	15.4	1.6	3.3	08/04	10.2	N	24.7	22/01	1020.3
46051	34.5N	120.7W	0164	14.0	15.2	1.7	2.6	03/06	10.1	NW	21.2	01/05	1011.2
51001	23.4N	162.3W	0741	25.5	26.6	2.1	3.7	25/18	13.2	E	23.1	25/08	1017.6
51002	17.2N	157.8W	0738	26.2	26.6	2.2	3.5	25/23	14.0	E	23.2	19/10	1014.0
51003	19.2N	160.8W	0741	25.8	26.8	1.8	2.8	27/02	11.7	E	22.2	22/02	1014.2
51004	17.4N	152.5W	0736	25.5	26.3	2.2	3.4	24/09	14.3	E	22.8	25/19	1013.8
51026	21.4N	157.0W	0736	24.9	25.5	1.9	4.0	24/21	15.2	E	23.9	25/04	1015.9
52009	13.7N	144.7E	0508		27.4	1.1	1.8	03/22	10.5	E	20.2	26/05	1009.2
91222	18.1N	145.8E	0735	28.3					8.2	E	24.3	20/19	1010.6
91251	11.4N	162.4E	0729	27.8					14.9	E	26.9	17/01	1010.1
91328	8.6N	149.7E	0730	27.9					5.9	NE	22.9	18/20	1008.7
91338	5.3N	153.7E	0730	27.6					4.4	NE	21.4	15/10	1008.3
91343	7.6N	155.2E	0628	27.7					7.6	NE	23.0	23/10	1008.3
91352	6.2N	160.7E	0730	27.5					5.6	E	28.7	21/13	1009.1
91355	5.4N	163.0E	0731	26.7					4.9	E	14.6	19/14	1008.3
91377	6.1N	172.1E	0732	27.5					8.8	NE	27.1	17/14	1009.3
ABAN6	44.3N	075.9W	0741	21.4	19.9				2.9	S	14.6	26/18	1013.2
ALSN6	40.5N	073.8W	0741	23.7		0.6	2.3	20/01	12.7	W	34.2	19/23	1014.1
BURL1	28.9N	089.4W	0738	28.3					7.2	S	25.8	21/13	1017.6
BUSL1	27.9N	090.9W	0741	29.7									
CARO3	43.3N	124.4W	0480	13.8					8.6	N	25.8	22/07	1019.0
CHLV2	36.9N	075.7W	0743	25.7		0.6	1.3	27/01	10.1	S	26.4	30/04	1016.0
CLKN7	34.6N	076.5W	0741	27.7					9.3	SW	31.2	04/22	1016.7
CSBF1	29.7N	085.4W	0737	28.2					6.8	W	23.2	13/20	1017.0
DBLN6	42.5N	079.4W	0740	22.2					9.6	SW	29.4	29/22	1015.1
DESW1	47.7N	124.5W	0740	13.7					7.1	NW	22.9	29/12	1018.8
DISW3	47.1N	090.7W	0739	15.5					9.1	SW	28.0	26/15	1012.3
DPIA1	30.3N	088.1W	0739	28.1	30.1				7.2	SW	30.0	30/02	1016.9
DRYF1	24.6N	082.9W	0740	29.0	30.0				6.1	E	26.9	14/05	1017.7
DSLN7	35.2N	075.3W	0743	27.0					12.3	SW	28.4	29/22	1016.5
FBIS1	32.7N	079.9W	0743	28.5					7.8	SW	18.0	25/20	1016.3
FFIA2	57.3N	133.6W	0737	13.9					5.1	N	16.6	12/08	1017.3
FPSN7	33.5N	077.6W	0273	27.6	27.9				9.7	SW	21.7	04/07	1017.7
FWYF1	25.6N	080.1W	0743	28.6	29.8				8.4	E	22.8	14/18	1018.3
GDIL1	29.3N	090.0W	0730	28.4	30.6				6.5	S	21.6	08/23	1017.1
GLLN6	43.9N	076.5W	0689	20.7					12.8	W	29.4	22/19	1013.6
IOSN3	43.0N	070.6W	0742	19.5					10.7	W	23.2	30/23	1013.0
LONF1	24.9N	080.9W	0741	29.0	31.6				7.3	E	20.0	25/04	1017.7
MDRM1	44.0N	068.1W	0742	14.1					11.5	W	26.0	22/01	1012.8
MISM1	43.8N	068.9W	0742	15.5					11.9	W	25.3	27/23	1012.9
MLRF1	25.0N	080.4W	0742	28.6	29.7				7.0	SE	19.7	14/21	1017.3
NWPO3	44.6N	124.1W	0742	13.7					7.4	N	26.0	22/05	1019.8
PILM4	48.2N	088.4W	0742	10.9					11.9	W	29.9	06/22	1013.6
PTAC1	39.0N	123.7W	0741	11.7					11.2	N	24.2	13/11	1014.9
ROAM4	47.9N	089.3W	0741	14.0					11.7	SW	31.6	05/00	1013.2
SANF1	24.5N	081.9W	0744	28.7	30.4				7.3	SE	22.6	11/05	1017.3
SAUF1	29.9N	081.3W	0727	26.6	28.4				7.0	SW	19.8	05/21	1017.4
SBIO1	41.6N	082.8W	0743	23.8					9.7	SW	32.0	30/00	1015.7
SGNW3	43.8N	087.7W	0742	19.5					9.2	S	24.2	09/14	1013.5
SISW1	48.3N	122.9W	0738	12.9					9.6	SW	24.1	04/05	1018.3
SMKF1	24.6N	081.1W	0740	29.2	30.1				7.8	E	27.2	11/20	1018.1
SPGF1	26.7N	079.0W	0741	28.2	29.8				3.8	SE	20.4	31/21	1019.3
SRST2	29.7N	094.1W	0738	28.7					11.1	S	21.8	05/13	1016.6
SVLS1	32.0N	080.7W	0740	28.2		0.6	1.3	16/06	10.5	S	28.9	29/23	1016.5
TTTIW1	48.4N	124.7W	0741	12.7					8.5	SW	20.9	08/21	1019.0
VENF1	27.1N	082.5W	0735	27.5	31.2				6.6	W	20.6	09/23	1018.0
WPOW1	47.7N	122.4W	0734	14.6					4.9	S	19.2	22/21	1017.5

BUOY AUGUST	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
32302	18.0S	085.1W	0740	17.6	18.6	2.3	4.1	16/23	13.3	E	22.0	08/05	1016.9
41001	34.7N	072.7W	0740	26.0	26.9	1.4	5.5	31/14	9.5	E	26.4	31/20	1017.2
41002	32.3N	075.2W	0371	27.0	27.9	1.2	4.3	31/06	9.3	SW	34.2	31/08	1017.0
41004	32.5N	079.1W	0739	27.5	28.4	0.7	2.5	31/10	9.3	SW	23.7	07/21	1016.3
41006	29.3N	077.4W	0744	27.9	29.1	1.1	2.1	11/04	8.7	SW	24.1	11/06	1017.1
41009	28.5N	080.2W	1482	27.6	28.3	0.6	2.1	30/07	9.2	SE	22.9	10/18	1016.8
41010	28.9N	078.5W	1482	28.1	29.0	1.0	2.7	29/21	9.1	S	26.6	27/14	1017.3
41016	24.6N	076.5W	0741	28.7	29.8	0.4	1.9	25/18	9.0	SE	31.4	25/16	1017.1
42001	25.9N	089.7W	0741	28.9	30.0	0.4	1.3	26/08	7.4	SE	21.2	18/07	1016.9
42002	25.9N	093.6W	0741	29.2	30.0	0.6	1.4	26/17	8.0	SE	24.3	25/23	1016.1
42003	25.9N	085.9W	0743	29.0	30.1	0.5	1.5	05/12	8.1	W	21.4	24/13	1017.1
42007	30.1N	088.8W	0739	28.7	30.1				8.5	SW	24.9	26/18	1016.5
42019	27.9N	095.0W	0743	30.7	29.4	0.8	1.7	23/13	7.7	S	16.0	23/11	1015.8
44004	38.5N	070.7W	0743	23.4	23.9	1.3	2.8	07/03	9.6	NE	30.3	07/04	1017.2
44005	42.6N	068.6W	0744	19.1	19.4	1.0	2.1	28/18	8.7	S	21.4	21/16	1017.1
44007	43.5N	070.1W	0741	17.9	16.2	0.6	2.2	31/22	7.5	S	25.6	31/22	1017.3
44008	40.5N	069.4W	0742	19.2	17.8	1.0	3.1	31/07	8.8	NE	28.8	07/09	1017.6
44009	38.5N	074.7W	0742	23.4	23.4	0.8	3.3	07/01	8.7	S	30.5	06/22	1017.2
44011	41.1N	066.6W	0742	17.8	17.6	1.1	2.9	07/22	8.4	N	23.7	07/16	1017.4
44013	42.4N	070.8W	0742	19.9	18.4	0.4	1.4	15/11	8.4	SE	21.6	31/18	1017.2
44014	36.6N	074.8W	0741	24.5	25.0	0.8	5.2	31/23	9.4	NE	31.9	31/23	1016.6
44025	40.3N	073.2W	0742	22.5	22.5	0.9	2.9	07/12	9.7	S	22.3	07/00	1016.6
45001	48.1N	087.8W	0741	12.4	10.5	0.4	1.2	09/18	8.1	SW	19.4	31/01	1015.3
45002	45.3N	086.4W	0744	19.8	20.3	0.5	1.9	09/23	8.9	S	24.5	31/07	1015.3
45003	45.3N	082.7W	0742	18.2	17.8	0.5	2.2	28/06	7.9	S	25.8	28/05	1015.6
45004	47.6N	086.5W	0514	13.4	11.7	0.4	1.3	20/16	7.2	SE	18.3	20/12	1015.5
45005	41.7N	082.4W	0738	23.0	23.9	0.4	1.5	30/00	8.0	SW	20.2	21/01	1016.6
45006	47.3N	089.9W	0742	16.5	14.8	0.5	2.1	31/14	6.9	SW	18.1	31/14	1014.6
45007	42.8N	087.1W	0743	21.6	22.0	0.5	2.1	21/02	8.9	S	29.9	09/19	1015.4
45008	44.3N	082.4W	0741	20.3	20.4	0.6	2.0	31/16	8.1	SE	20.1	31/13	1016.3
45010	43.0N	087.8W	0735	20.1	19.5	0.4	1.9	21/04	6.7	SE	24.1	09/18	1015.5
46001	56.3N	148.2W	0736	13.4	14.0	2.2	6.7	19/09	14.1	W	32.3	19/06	1017.2
46002	42.5N	130.3W	0724	16.5	16.9	2.0	3.9	23/07	11.7	N	23.9	03/02	1021.4
46003	51.9N	155.9W	0587	11.5	11.6	2.5	6.7	18/14	12.7	SW	22.5	14/17	1014.3
46005	46.1N	131.0W	0532	15.5	16.0	1.8	3.7	07/19	12.3	NW	30.3	22/20	1020.2
46006	40.9N	137.5W	0737	17.4	18.0	1.7	4.2	22/12	10.9	N	27.2	22/10	1025.9
46013	38.2N	123.3W	0738	13.2	12.2	1.7	4.2	24/09	12.9	NW	29.5	24/01	1013.1
46014	39.2N	124.0W	0732	13.4	12.7	1.9	4.5	25/01	11.2	NW	30.1	24/23	1014.4
46022	40.8N	124.5W	0734	13.9	13.3	1.9	5.1	25/02	9.5	N	29.5	25/01	1015.5
46023	34.3N	120.7W	0738	15.6	15.8	1.8	3.0	25/12					1013.5
46025	33.8N	119.1W	0740	18.1	19.8	0.9	1.6	06/05	5.7	W	14.2	05/00	1013.3
46026	37.8N	122.7W	0735	14.2	14.8	1.2	2.6	24/10	10.2	W	24.7	13/01	1014.2
46028	35.8N	121.9W	0737	15.2	17.7	1.9	4.1	25/08	11.6	NW	27.4	21/03	1014.3
46029	46.2N	124.2W	0742	16.0	14.9	1.5	3.2	24/00	9.1	N	23.2	23/01	1018.0
46030	40.4N	124.5W	0734	12.6	10.9	1.6	4.2	25/03					1015.2
46035	57.0N	177.7W	0702	9.7	9.8	1.6	5.9	19/16	12.6	SW	37.3	19/12	1012.1
46041	47.4N	124.5W	0729	14.9	15.4	1.4	3.5	24/01	7.7	NW	22.7	01/23	1018.0
46042	36.8N	122.4W	0731	14.8		1.7	3.9	24/20	9.9	NW	23.7	19/01	1014.7
46045	33.8N	118.5W	0737	18.6	19.8	0.5	1.2	31/03	5.6	SW	12.6	31/03	1012.7
46047	32.7N	119.6W	0041	18.0	18.5	1.4	1.5	01/01	12.8	W	17.7	02/00	1014.3
46048	32.9N	117.9W	0041	19.2	20.5	0.8	1.1	01/00	6.9	NW	11.1	01/01	1013.0
46050	44.6N	124.5W	0724	14.9	14.1	1.6	3.7	24/00	9.5	N	25.1	02/07	1018.4
46053	34.2N	119.9W	0623	17.0	18.1	0.9	1.9	07/01	9.8	W	25.3	12/22	1012.6
46054	34.3N	120.5W	0169	15.4	16.4	1.8	3.0	25/04	10.0	W	21.2	31/21	1013.1
51001	23.4N	162.3W	0742	26.0	26.9	1.9	4.1	17/05	11.8	E	22.1	16/15	1017.2
51002	17.2N	157.8W	0741	26.9	27.3	2.2	4.3	17/00	13.1	E	24.0	13/18	1013.8
51003	19.2N	160.8W	0740	26.7	27.6	1.8	2.9	15/00	11.1	E	20.9	12/02	1014.0
51004	17.4N	152.5W	0737	26.2	26.9	2.2	4.8	16/04	13.8	E	23.0	13/06	1013.3
51026	21.4N	157.0W	0734	25.4	26.1	2.0	4.7	17/16	14.3	E	21.4	14/09	1015.4
52009	13.7N	144.7E	0408		27.2	1.8	4.2	06/13	11.0	SW	25.3	03/14	1008.7
91222	18.1N	145.8E	0734	28.0					5.8	E	20.6	05/03	1009.4

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
91251	11.4N	162.4E	0652	27.8					9.7	E	24.0	16/14	1010.9
91328	8.6N	149.7E	0655	27.2					6.7	SW	24.6	19/23	1009.7
91338	5.3N	153.7E	0657	27.1					7.4	S	25.1	04/02	1009.9
91343	7.6N	155.2E	0655	27.2					4.2	SW	22.8	01/17	1009.8
91352	6.2N	160.7E	0656	27.3					5.7	SW	23.2	17/20	1010.7
91355	5.4N	163.0E	0657	26.7					7.1	E	30.8	17/10	1010.0
91377	6.1N	172.1E	0718	28.0					5.5	NE	19.6	31/18	1010.9
ABAN6	44.3N	075.9W	0743	20.9	21.7				2.9	S	11.1	21/07	1015.9
ALSN6	40.5N	073.8W	0743	22.4		0.8	2.3	07/16	10.9	S	28.0	17/11	1016.6
BURL1	28.9N	089.4W	0737	28.8					7.9	W	22.3	16/09	1016.9
BUSL1 S	27.9N	090.9W	0738		30.7				7.2				
CARO3	43.3N	124.4W	0730	13.6					6.9	NE	23.7	30/21	1018.5
CHLV2	36.9N	075.7W	0743	23.7		0.7	1.2	02/23	10.4	S	34.9	06/19	1017.9
CLKN7	34.6N	076.5W	0744	26.3					9.8	NE	30.9	31/19	1017.9
CSBF1	29.7N	085.4W	0739	28.2					6.8	W	20.9	15/10	1016.4
DBLN6	42.5N	079.4W	0742	21.6					7.6	SW	22.8	20/21	1017.0
DESW1	47.7N	124.5W	0734	14.7					7.9	NW	36.9	22/23	1018.0
DISW3	47.1N	090.7W	0737	18.6					8.5	SW	25.4	31/11	1014.4
DPIA1	30.3N	088.1W	0740	28.3	30.2				7.1	SW	19.0	01/23	1016.3
DRYF1	24.6N	082.9W	0743	29.1	30.2				7.2	E	21.6	26/03	1017.0
DSLN7	35.2N	075.3W	0742	25.8					12.5	NE	89.4	31/23	1017.5
FBIS1	32.7N	079.9W	0744	27.4					8.7	E	21.8	15/17	1017.3
FFIA2	57.3N	133.6W	0731	13.2					6.4	N	27.8	08/17	1018.8
FPSN7	33.5N	077.6W	0483	26.8	28.0				8.8	NE	22.2	14/12	1017.1
FWYF1	25.6N	080.1W	0744	28.8	30.1				10.0	E	26.2	14/00	1017.5
GDIL1	29.3N	090.0W	0735	28.7	30.8				7.1	SW	34.7	19/20	1016.5
GLLN6	43.9N	076.5W	0744	21.4					9.6	SE	25.2	04/09	1015.6
IOSN3	43.0N	070.6W	0738	19.5					9.7	S	28.7	31/22	1016.7
LONF1	24.9N	080.9W	0741	29.0	30.9				8.1	E	21.3	03/03	1017.0
MDRM1	44.0N	068.1W	0721	15.0					9.8	SW	27.2	31/23	1016.8
MISM1	43.8N	068.9W	0731	15.3					10.6	SW	29.8	31/22	1016.8
MLRF1	25.0N	080.4W	0743	28.8	30.3				8.7	E	29.4	16/22	1016.5
NWPO3	44.6N	124.1W	0729	13.9					7.3	N	30.7	02/01	1017.9
PILM4	48.2N	088.4W	0744	15.7					10.4	W	26.1	01/16	1015.2
PTAC1	39.0N	123.7W	0734	13.3					10.5	N	27.5	25/05	1014.5
PTAT2	27.8N	097.1W	0739	28.3	30.0				11.7	SE	20.7	22/06	1014.1
PTGC1	34.6N	120.7W	0732	14.9					14.5	N	28.4	11/08	1013.4
ROAM4	47.9N	089.3W	0740	16.8					11.2	SW	26.1	01/04	1015.0
SANF1	24.5N	081.9W	0742	28.9	30.5				8.0	SE	21.8	05/02	1016.6
SAUF1	29.9N	081.3W	0740	26.7	28.1				7.9	SW	25.7	15/21	1017.2
SBIO1	41.6N	082.8W	0744	23.3					7.8	SW	33.9	03/23	1017.4
SGNW3	43.8N	087.7W	0744	21.0					8.3	S	26.8	09/17	1015.1
SISW1	48.3N	122.9W	0733	13.7					8.2	W	28.7	23/16	1018.0
SMKF1	24.6N	081.1W	0742	29.2	30.5				8.7	E	28.9	12/22	1017.3
SPGF1	26.7N	079.0W	0744	28.2	30.0				5.1	SE	20.3	10/04	1018.6
SRST2	29.7N	094.1W	0709	28.8					9.2	S	27.0	26/01	1016.4
SVLS1	32.0N	080.7W	0718	27.4		0.6	1.3	02/11	11.1	E	23.8	03/22	1017.1
TIW1	48.4N	124.7W	0738	13.7					8.7	SW	35.1	23/04	1018.5
VENF1	27.1N	082.5W	0740	27.4	31.0				7.4	E	19.3	25/19	1017.3
WPOW1	47.7N	122.4W	0560	16.0					4.1	NE	15.9	23/10	1015.9
SEPTEMBER													
32302	18.0S	085.1W	0716	17.5	18.6	2.2	3.8	08/01	12.4	E	22.9	07/09	1016.9
41001	34.7N	072.7W	0717	25.1	26.4	1.3	5.1	01/04	11.8	S	29.7	01/05	1018.2
41002	32.3N	075.2W	0225	26.0	27.4	0.9	1.8	27/13	9.6	S	18.3	29/05	1017.4
41004	32.5N	079.1W	0713	26.6	27.9	0.8	2.0	10/07	9.9	S	22.0	10/07	1016.8
41006	29.3N	077.4W	0718	27.7	28.7	1.1	2.2	20/20	8.4	E	20.0	29/14	1017.4
41009	28.5N	080.2W	1432	27.8	29.3	0.7	1.7	02/02	9.4	SE	26.6	14/15	1016.9
41010	28.9N	078.5W	1434	27.9	28.9	1.0	2.2	01/09	8.7	E	21.8	29/13	1017.4
41016	24.6N	076.5W	0718	28.5	29.8	0.4	1.3	14/18	9.9	E	21.9	01/15	1015.8
42001	25.9N	089.7W	0716	28.2	29.5	0.8	2.6	30/03	11.3	E	29.3	18/14	1015.6
42002	25.9N	093.6W	0717	28.5	29.4	0.9	3.3	20/22	11.1	E	24.9	28/00	1014.7

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
42003	25.9N	085.9W	0718	28.6	29.5	0.7	3.5	30/01	9.9	E	24.5	15/12	1016.2
42007	30.1N	088.8W	0715	26.9	28.9				9.2	NE	25.3	14/19	1016.3
42019	27.9N	095.0W	0718	29.8	29.3	1.0	3.7	14/07	10.4	E	26.5	14/06	1015.0
44004	38.5N	070.7W	0718	22.3	23.4	1.4	9.9	01/17	10.5	S	59.7	01/19	1017.1
44005	42.6N	068.6W	0487	17.0	17.8	1.3	3.2	28/03	12.8	SW	28.4	26/19	1014.8
44007	43.5N	070.1W	0718	14.8	14.1	0.7	2.1	10/14	10.7	SW	32.1	28/11	1016.4
44008	40.5N	069.4W	0717	18.3	18.2	1.2	3.3	01/23	11.4	SW	28.8	28/02	1017.2
44009	38.5N	074.7W	0717	21.3	21.8	0.9	2.2	01/20	10.4	S	23.9	11/05	1017.3
44011	41.1N	066.6W	0718	17.8	17.8	1.4	3.8	02/06	10.1	SW	24.9	26/21	1017.4
44013	42.4N	070.8W	0710	16.2	15.0	0.4	1.6	17/22	11.0	SW	26.2	28/10	1016.6
44014	36.6N	074.8W	0713	23.2	24.2	0.8	7.4	01/04	9.4	S	54.8	01/04	1016.9
44025	40.3N	073.2W	0718	19.9	20.5	1.1	2.7	28/08	12.1	S	27.0	28/08	1016.3
45001	48.1N	087.8W	0716	10.3	10.7	0.9	3.5	30/22	13.2	SW	29.3	30/21	1014.5
45002	45.3N	086.4W	0717	13.9	20.5	0.9	3.6	09/12	13.7	S	32.8	09/10	1014.9
45003	45.3N	082.7W	0718	13.2	14.1	0.8	2.7	09/17	11.7	NW	28.8	09/16	1014.9
45004	47.6N	086.5W	0717	10.5	11.0	0.9	3.4	30/22	12.2	S	28.4	09/08	1014.3
45005	41.7N	082.4W	0716	17.5	20.3	0.6	2.5	28/01	12.2	S	33.6	28/01	1016.3
45006	47.3N	089.9W	0718	11.3	11.7	0.9	2.3	09/03	9.8	SW	21.8	09/03	1014.4
45007	42.8N	087.1W	0718	15.7	18.0	0.8	2.9	12/16	12.3	NW	29.1	09/12	1015.6
45008	44.3N	082.4W	0718	15.3	18.4	1.0	2.8	09/19	11.3	SW	25.2	09/19	1015.7
45010	43.0N	087.8W	0715	13.9	14.1	0.6	1.9	20/16	9.0	NW	23.9	09/14	1015.7
46001	56.3N	148.2W	0714	11.7	12.4	2.5	6.1	28/23	15.8	W	32.8	28/19	1018.8
46002	42.5N	130.3W	0474	16.2	17.1	1.8	3.0	20/01	14.3	N	21.2	22/22	1022.0
46003	51.9N	155.9W	0716	11.2	11.2	2.3	5.2	30/20	15.9	S	28.2	20/18	1018.0
46005	46.1N	131.0W	0459	15.3	16.1	1.6	3.1	20/00	12.8	N	19.2	19/22	1023.8
46006	40.9N	137.5W	0715	17.7	18.6	1.4	2.9	01/00	9.5	NE	23.3	19/15	1024.2
46013	38.2N	123.3W	0714	12.1	12.4	1.6	3.2	13/02	11.9	NW	26.6	12/00	1014.3
46014	39.2N	124.0W	0714	12.4	12.7	1.6	3.7	13/00	10.8	NW	27.6	12/05	1015.5
46022	40.8N	124.5W	0712	11.8	11.5	1.5	4.1	13/04	7.3	N	24.1	12/20	1016.4
46023	34.3N	120.7W	0716	15.1	15.4	1.7	3.3	12/06					1013.7
46025	33.8N	119.1W	0717	18.0	19.6	1.0	1.7	13/00	5.5	W	13.2	04/01	1014.1
46026	37.8N	122.7W	0714	12.7	14.1	1.1	1.9	12/03	9.6	NW	24.3	05/03	1015.2
46027	41.9N	124.4W	0712	11.5	11.0	1.4	3.4	20/03	7.4	NW	30.9	20/23	1016.2
46028	35.8N	121.9W	0718	14.7	18.0	1.7	3.2	11/15	13.8	NW	29.3	12/02	1014.8
46029	46.2N	124.2W	0716	14.1	13.4	1.3	3.1	12/13	8.6	N	20.2	22/02	1018.5
46030	40.4N	124.5W	0717	11.3	10.5	1.3	3.5	12/20	12.7	N	22.5	29/09	1015.9
46035	57.0N	177.7W	0696	7.7	8.6	2.2	8.2	13/21	15.4	N	38.7	13/20	1011.0
46041	47.4N	124.5W	0700	11.7	12.6	1.2	3.2	12/08	6.5	NW	19.4	29/20	1018.8
46042	36.8N	122.4W	0713	13.7		1.5	2.9	12/16	11.5	NW	23.7	09/23	1015.4
46045	33.8N	118.5W	0714	18.4	19.4	0.6	1.3	18/05	5.4	SW	14.8	21/23	1012.8
46050	44.6N	124.5W	0690	12.7	12.2	1.4	3.0	19/23	8.1	N	20.6	26/01	1018.9
46053	34.2N	119.9W	0719	16.9	18.2	0.8	1.9	12/02	10.1	W	26.8	17/22	1012.8
46054	34.3N	120.5W	0719	15.1	15.8	1.5	2.9	12/03	16.8	NW	33.2	12/06	1013.8
51001	23.4N	162.3W	0716	26.1	27.3	1.6	2.9	29/17	8.8	E	19.6	15/11	1015.8
51002	17.2N	157.8W	0716	27.0	27.7	1.7	2.6	06/16	11.0	NW	19.9	06/08	1013.5
51003	19.2N	160.8W	0716	26.9	28.0	1.5	2.7	30/14	9.2	E	22.7	23/21	1013.3
51004	17.4N	152.5W	0718	26.5	27.4	1.8	2.9	25/04	11.9	E	20.5	05/17	1013.2
51026	21.4N	157.0W	0714	25.8	26.7	1.4	2.6	30/06	11.9	E	19.4	30/13	1014.6
52009	13.7N	144.7E	0421		27.6	1.1	4.0	30/13	9.0	E	38.5	30/14	1009.7
91222	18.1N	145.8E	0705	28.0					7.0	E	31.1	25/02	1009.9
91251	11.4N	162.4E	0641	28.0					8.7	E	20.3	29/03	1010.5
91328	8.6N	149.7E	0650	27.5					6.1	SW	25.1	22/22	1009.6
91338	5.3N	153.7E	0645	27.4					4.6	SW	24.8	20/22	1009.5
91343	7.6N	155.2E	0649	27.5					4.1	NE	18.2	16/17	1009.3
91352	6.2N	160.7E	0651	27.7					4.1	SW	17.4	21/18	1010.2
91355	5.4N	163.0E	0649	26.8					5.2	E	18.2	29/19	1009.5
91377	6.1N	172.1E	0680	28.5					5.1	NE	17.3	16/08	1010.8
ABAN6	44.3N	075.9W	0716	15.1	19.7				3.8	S	15.5	15/01	1015.6
ALSN6	40.5N	073.8W	0696	19.3	17.9	0.8	2.1	16/23	13.1	SW	33.3	27/18	1016.4
BURL1	28.9N	089.4W	0716	27.6					8.7	E	28.6	15/08	1016.3
BUSL1	27.9N	090.9W	0717		29.9				9.6	E	25.4	06/16	1019.6
BUZM3	41.4N	071.0W	0718	17.8					14.4	SW	33.9	26/16	1016.5
CARO3	43.3N	124.4W	0705	12.0					6.2	NE	20.3	21/19	1018.4
CHLV2	36.9N	075.7W	0718	22.6					11.7	S	36.3	01/05	1018.1
CLKN7	34.6N	076.5W	0717	25.3					10.2	SW	22.2	01/00	1018.4
CSBF1	29.7N	085.4W	0716	26.8					5.9	NE	26.0	09/13	1016.4
DBLN6	42.5N	079.4W	0717	16.2					10.3	S	44.3	28/05	1016.5

NDBC Station Data Summary

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
DESW1	47.7N	124.5W	0711	11.7					6.3	NW	24.9	30/00	1018.7
DISW3	47.1N	090.7W	0703	11.6					11.5	SW	27.9	13/22	1014.3
DPIA1	30.3N	088.1W	0716	26.7	28.8				8.4	NE	24.3	28/06	1016.2
DRYF1	24.6N	082.9W	0718	28.6	30.3				9.5	E	23.4	30/11	1015.9
DSLN7	35.2N	075.3W	0718	24.9	26.6	1.1	2.6	27/18	13.0	SW	71.0	01/00	1017.7
FBIS1	32.7N	079.9W	0716	26.1					8.8	SW	20.3	29/15	1017.7
FFIA2	57.3N	133.6W	0710	10.7					7.4	SE	36.4	22/20	1020.2
FPSN7	33.5N	077.6W	0594	26.4	27.5				10.5	SW	24.3	11/11	1018.4
FWYF1	25.6N	080.1W	0718	28.4	29.7				10.9	E	37.8	01/22	1016.2
GDIL1	29.3N	090.0W	0710	27.4	29.4				8.1	SE	23.6	27/10	1016.0
GLLN6	43.9N	076.5W	0715	16.5					12.9	S	43.0	28/10	1014.8
IOSN3	43.0N	070.6W	0718	15.3					12.1	SW	30.3	28/07	1015.8
LONF1	24.9N	080.9W	0718	28.4	29.7				9.9	E	31.0	14/00	1016.0
MDRM1	44.0N	068.1W	0717	13.0					13.7	SW	30.5	28/06	1015.4
MISM1	43.8N	068.9W	0717	13.3					13.4	SW	36.8	28/03	1015.5
MLRF1	25.0N	080.4W	0717	28.5	29.9				10.1	E	28.5	14/06	1015.5
NWPO3	44.6N	124.1W	0710	11.7					5.9	N	21.3	30/23	1018.2
PILM4	48.2N	088.4W	0717	10.2					13.9	W	37.1	23/02	1014.7
PTAC1	39.0N	123.7W	0717	11.9					9.7	N	22.3	11/07	1015.5
PTAT2	27.8N	097.1W	0509	27.6	29.1				11.8	SE	31.0	13/17	1013.8
PTGC1	34.6N	120.7W	0715	14.0					15.4	N	31.9	12/08	1013.6
ROAM4	47.9N	089.3W	0715	10.0					14.0	SW	36.4	09/05	1014.7
SANF1	24.5N	081.9W	0716	28.4	29.8								1015.4
SAUF1	29.9N	081.3W	0717	26.3	28.6				8.4	SE	24.4	27/00	1017.6
SBIO1	41.6N	082.8W	0717	17.2					11.0	NE	37.8	28/00	1017.3
SGNW3	43.8N	087.7W	0718	13.4					10.4	W	31.6	30/22	1015.3
SISW1	48.3N	122.9W	0711	12.0					5.9	SW	26.4	11/03	1018.7
SMKF1	24.6N	081.1W	0716	28.7	29.8				11.1	E	31.5	14/08	1016.3
SPGF1	26.7N	079.0W	0718	28.1	29.7				6.6	E	18.2	12/16	1018.1
SRST2	29.7N	094.1W	0701	26.4					10.0	S	28.9	14/06	1016.1
VLS1	32.0N	080.7W	0691	26.3					11.5	S	29.5	29/14	1017.6
TTIW1	48.4N	124.7W	0684	11.3					8.9	S	29.9	26/17	1019.1
VENF1	27.1N	082.5W	0714	26.4	30.1				6.7	E	22.2	13/21	1017.0
WPOW1	47.7N	122.4W	0476	13.2					3.1	NE	17.6	11/12	1019.0

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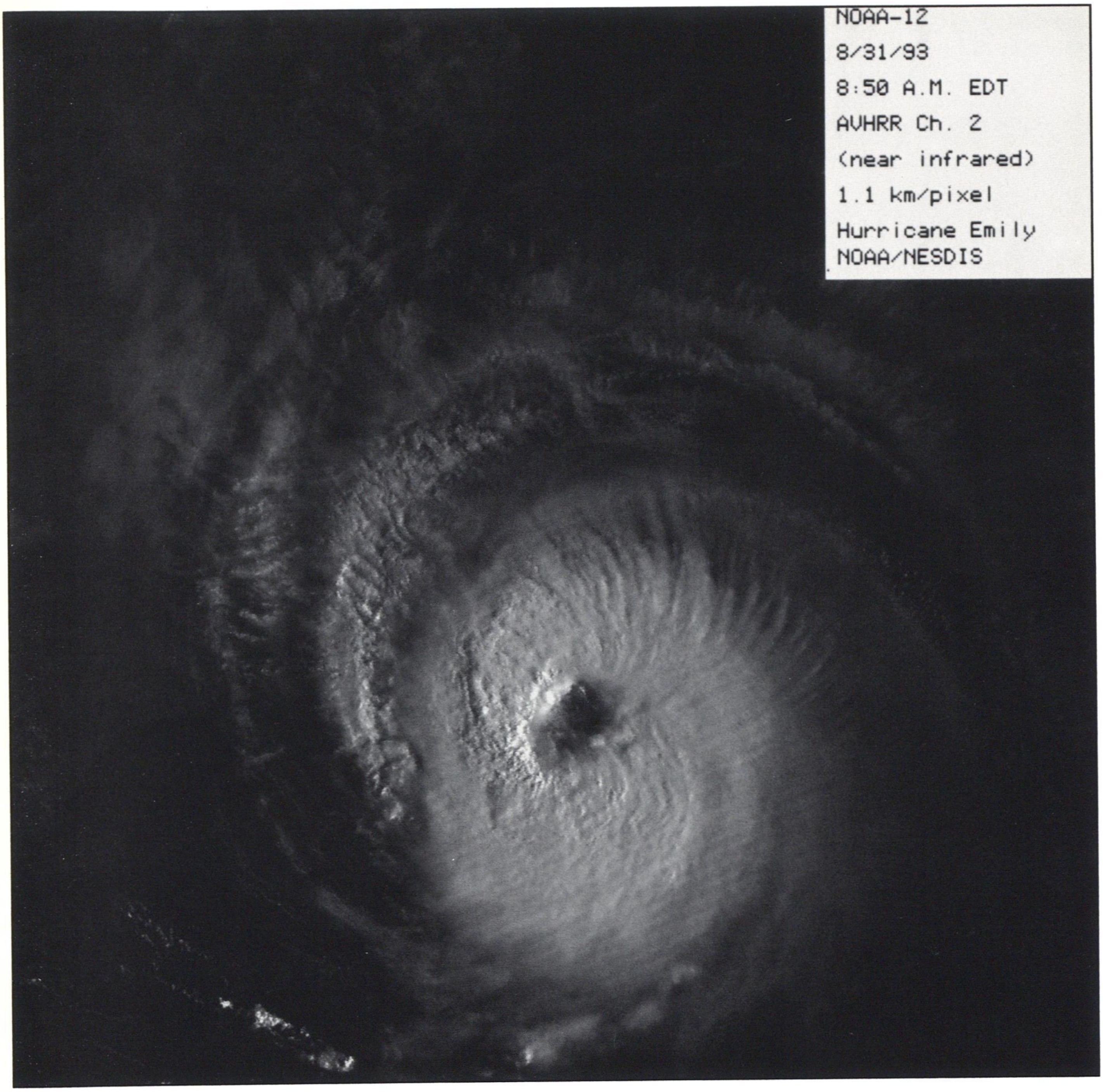

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