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Edward P. Ames

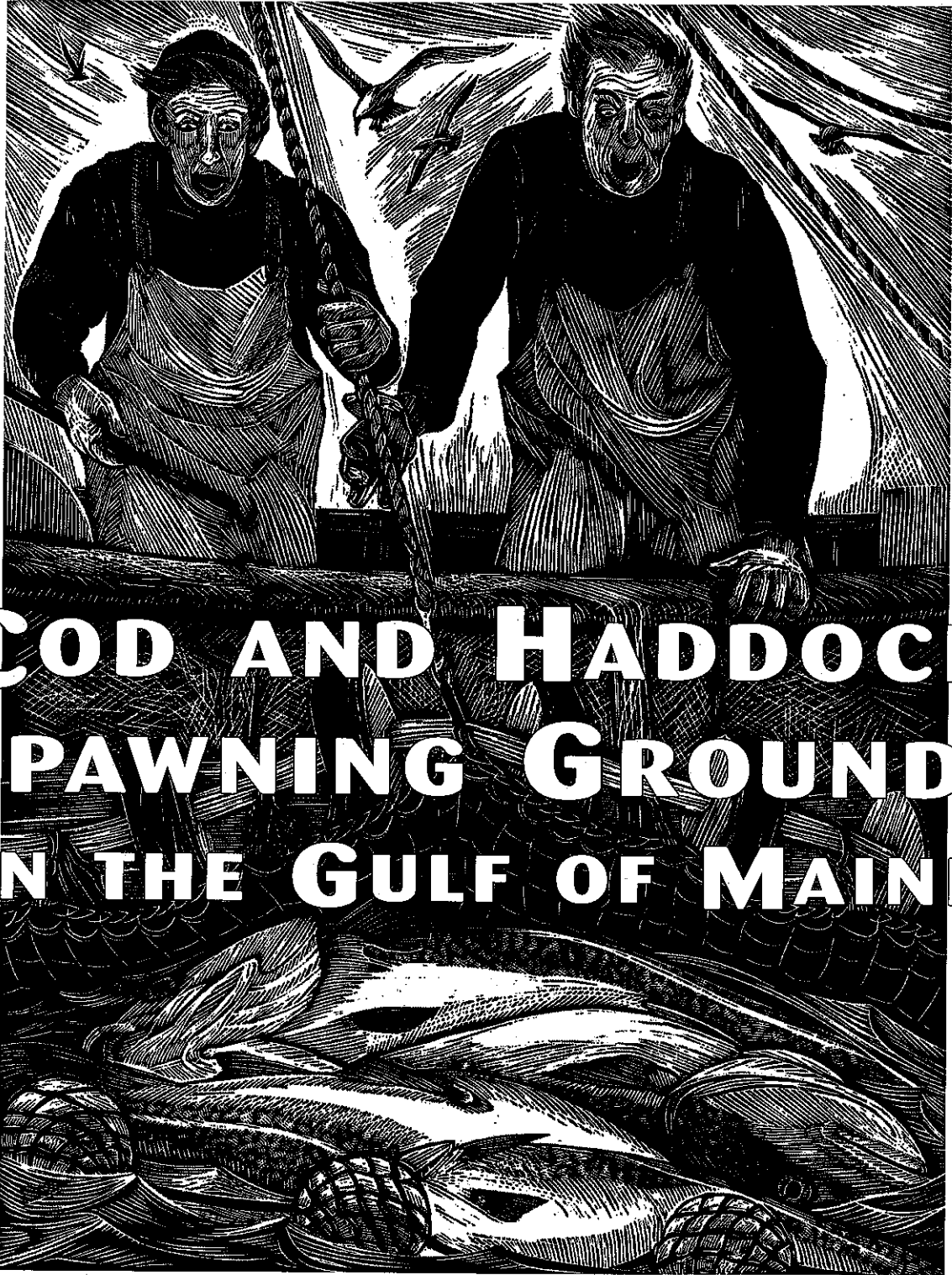
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**COD AND HADDOCK
SPAWNING GROUNDS
IN THE GULF OF MAINE**

I S L A N D I N S T I T U T E



**COD AND HADDOCK
SPAWNING GROUNDS
IN THE GULF OF MAINE**

**FROM GRAND MANAN CHANNEL
TO IPSWICH BAY**

EDWARD P. AMES

WITH MAPS AND SATELLITE IMAGES

INTRODUCTION BY
PHILIP W. CONKLING

I S L A N D I N S T I T U T E



ABSTRACT

This report presents the results of oral histories among retired fishermen in the State of Maine and New Hampshire. Spawning areas and former spawning areas for cod and haddock were identified in coastal waters extending from Grand Manan Channel to Ipswich Bay. Characteristics of these areas and a review of factors relating to the demise of these coastal stocks are included.

ACKNOWLEDGMENTS

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The illustration on the front cover is by Siri Beckman; the illustrations appearing on the title page and endpapers are by Margaret Campbell. Design and production of *Cod and Haddock Spawning Grounds in the Gulf of Maine* were handled by Charles G. Oldham, Publications Associate for the Island Institute.

Special thanks to the many fishermen who freely offered their time and guidance in an attempt to contribute to the recovery of groundfish in New England.



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**APRIL 7, 1942:
THE GREAT MACHIAS BAY COD RUN**



Begins on page 12

INTRODUCTION

At the Island Institute we have long believed that many skilled fishermen possess valuable scientific information, obscured by the few opportunities that exist to share such knowledge. The reasons for the discontinuity between fishermen and scientists are diverse and complex, and are not the subject of the present report. Nevertheless, beyond its significant findings concerning the locations of historic spawning grounds, we hope this publication will serve to illustrate the benefits of integrating fishermen's knowledge with other kinds of scientific information to enhance common sense fisheries conservation.

Ted Ames, the researcher and primary author of this report, grew up on Vinalhaven, an island fishing community twelve miles out in Penobscot Bay. Ames is descended from many generations of fishermen, some of whom fished the inshore grounds of the Gulf of Maine and left behind stories, rich in ecological detail, describing the locations of productive fishing grounds where cod, haddock, hake and other groundfish would appear at particular seasons of the year.

Ted left the island to attend the University of Maine at Orono, where he pursued a graduate degree in biology. But he kept getting lured back to the waterfront to go fishing with an uncle or brother, to earn tuition and break up the academic year. Finally he just went fishing. Investing in a small dragger with an otter trawl net, and later in sink gillnets, he followed the aggregations of cod, haddock and other groundfish from fishing ground to fishing ground along the edge and islands of the coast of Maine. Like other groundfishermen, he began mentally keeping notes on fish habits and fisheries habitats.

Ames is not the first to try to record such information systematically. The first effort, published in 1887, described in great detail the locations of fishing grounds, both inshore and offshore, where the entire American fleet fished (Goode, G.B., 1887). And no wonder – by the late 19th century, the United States rivaled Britain as the leading maritime nation and world fishing power. Our fisheries exports were an economic mainstay, not just of coastal New England, but also of rapidly expanding fishing ports on the Gulf Coast and in the Pacific Northwest.

The highly detailed information on fishing grounds published a century ago was gleaned from careful interviews with fishermen – not average fishermen, but those who were, often as not, the most successful "highliners" of a specific region or set of fishing grounds.

The 19th century fishing grounds maps of the Gulf of Maine, although primitive by today's standards, were revised and updated a half-century later. In 1929, Maine's Department of Sea and Shore Fisheries (today the Department of Marine Resources) assembled a new report on the locations of fishing grounds in the nearshore waters of the Gulf of Maine (Rich, 1929). In comparing Rich's updated maps with the older ones, it is striking how little the locations of fishing grounds had changed in half a century; few new grounds had been identified in the intervening 50 years. Moreover, the landings during this period, although of varying abundances for individual species, showed greater consistency for groundfish as a whole.

These early maps demonstrate particularly well that cod and haddock migrations are keyed to localized bottom habitats. The question as to whether these grounds may intersect with specific oceanographic conditions has never been addressed.



In 1995 Ted Ames began interviewing older fishermen who had successfully fished for groundfish along the coast of Maine. He asked where they had hauled in "ripe and running" cod and haddock. It is not surprising that fishermen's memories would be as good as they were; in navigating these waters, one

has to learn the bottom almost "by heart." Before fathometers became commercially available in the 1960s, virtually all of this navigation was done by triangulation, by lining up ranges, and by running timed compass courses. So these locations are geographically proximate. Never the less, the patterns are again striking.

It is surprising to see how far up into the major embayments along the middle of the Gulf of Maine spawning cod and haddock once ran — much further inland than anyone in the scientific community had previously identified. When Maine's territorial sea boundary is shown, it is also surprising to learn that over half of the identified spawning grounds are within waters under state jurisdiction.

The largest single spawning grounds lie between Cape Elizabeth and Wood Island, in Saco Bay.

In comparing Ames's map with the earlier maps, it would appear that the spring, summer, and fall fishing grounds identified by Goode and Rich lay further offshore. Did early Maine fishermen simply not know about these inshore spawning grounds? Ames and his colleague, Jim Wilson, a resource economist who has studied the fishing industry for two decades, have pointed out that until a fresh fish market for cod, and particularly for haddock, developed along the Maine coast in the 1920s and 1930s, spawning groundfish were not favored for salt cod because their flesh is weaker, dries poorly and produces an inferior product (Wilson, Watson and Ames, 1997, in press). The inference is that these fish were caught after they had spawned in fishing grounds further offshore later in the season.

When Ames's data are plotted on modern charts, it also begins to appear that many of these inshore populations of cod and haddock were keyed in on particular water depths and bottom characteristics during spawning. Some of these areas are located far up in the protected portions of embayments.

At the same time, eggs of cod and haddock that were spawned along the outer edge of the islands would tend to be washed along the Maine coast from east to west and the Eastern Maine Coastal Current, passing the mouths of bays where clockwise current eddies would tend to spin off of the counter-clockwise coastal gyre. Altogether, 1,069 square miles of cod and haddock spawning grounds were identified.

A closer examination of the deep water channels that lead into the major embayments of the Gulf of Maine from Passamaquoddy Bay westward, at least to Casco and Saco Bays, suggest they were once not only important migration routes for spawning cod and haddock aggregating in late winter, but also routes where larval entrainment might occur.

The information assembled here suggests that cod and haddock traveled far up these channels and spawned in and around the islands, over large sand and gravel beds laid down by the rivers that pour off the Gulf of Maine's vast upland watershed. The case of Penobscot Bay, as illustrated in the accompanying satellite image and bathymetric chart detail, suggests that at least some of these spawning beds were located within current-driven upwelling that create the conditions for self-perpetuating "blooms" of larval plankton feed. Because many of these areas were also close to even more protected nursery grounds further



Dressing and washing cod for drying. (Frank Claes collection)

up the embayments and in the estuarine environments, all the ingredients for a vast, and vastly productive, fishery came together.



The entire inshore Gulf of Maine fishery has nearly disappeared. From the interviews Ted Ames conducted, we begin to see a pattern of individual spawning runs disappearing on an almost bay-by-bay basis, beginning in the 1930s. One of these stories, an account of the discovery of the Machias Bay spawning ground, is told in this booklet, alongside Ames's description of his research findings. The question of why these individual runs that disappeared 50 years ago never reestablished themselves, even though populations offshore had not collapsed, raises the possibility that the inshore cod and haddock complex of the Gulf of Maine might actually consist of a system of individual spawning runs — much in the manner of the individual spawning runs of Atlantic salmon that return to specific rivers.

Richard Langton of the Department of Marine Resources has recently reviewed the data collected by his department during the last three to four decades. The data demonstrate that at least some of the cod tagged in Sheepscot Bay returned there in succeeding years. (Perkins, et. al., 1996.)

Admittedly, much of this information is fragmentary and raises more questions than it answers. But it also shows how the combination of scientific and expert fishermen's knowledge of the habits of cod and haddock, and of oceanographic structure in the marine environment, can contribute to fisheries science. The maps in this publication demonstrate how looking in detail at one particular embayment (in this case, Penobscot Bay) can shed light on important ecological relationships. New methods of locating important ecological features exist, and if these can be integrated with fishermen's knowledge into geographic information systems (GIS), an important new tool will be available for fisheries management.

No one knows whether cod and haddock will come back on their own — just that they haven't. Many fishermen believe that the absence of cod is directly related to the abundance of lobster, even though in localized instances, the cod had been gone for decades before lobsters began to increase in the late 1980s. However, there may be an important connection between increased lobster landings and the additional conservation regulations that lobstermen imposed on themselves during this period — the increased minimum gauge, V-notching and the escape vent to prevent "ghost" fishing.

It is arresting how little we know about the stock complexes of groundfish of inshore waters of the Gulf of Maine, not to mention the connections between these stocks and other parts of the marine ecosystem. But after harvesting these species for 400 years along this coast, isn't it about time to answer some of the basic questions?

— PHILIP W. CONKLING
ISLAND INSTITUTE
MARCH, 1997

OVERVIEW: RESTORING COD AND HADDOCK TO THE GULF OF MAINE

The Gulf of Maine (GOM) has been described as a semi-enclosed, relatively shallow ocean basin whose rim contains some of the most prolific fishing grounds in the northwest Atlantic. Browns Bank, Georges Bank and Cape Cod form the southern rim of the Gulf and had been heavily fished for 150 years before the recent collapse of groundfish stocks. By contrast, the Gulf's northern rim contains numerous small outcroppings along the edge of the major deep basins that provided excellent fishing for nearly four centuries. The deeply trenched coastline allowed populations of cod and haddock to inhabit all the major bays as well. These grounds quickly gained a reputation for yielding the highest quality fish and, being located so close to land, were predictably fished intensively once they were discovered.

Decades of intense fishing by modern fishing trawlers within the Gulf of Maine and Georges Bank have caused a drastic decline in groundfish abundance. Accompanying this decline has been a growing concern about the ability of marine ecosystems to withstand such harvesting efforts. Commercial fishing in New England is threatened, and the very survival of Maine's traditional inshore fishing fleet is in doubt.

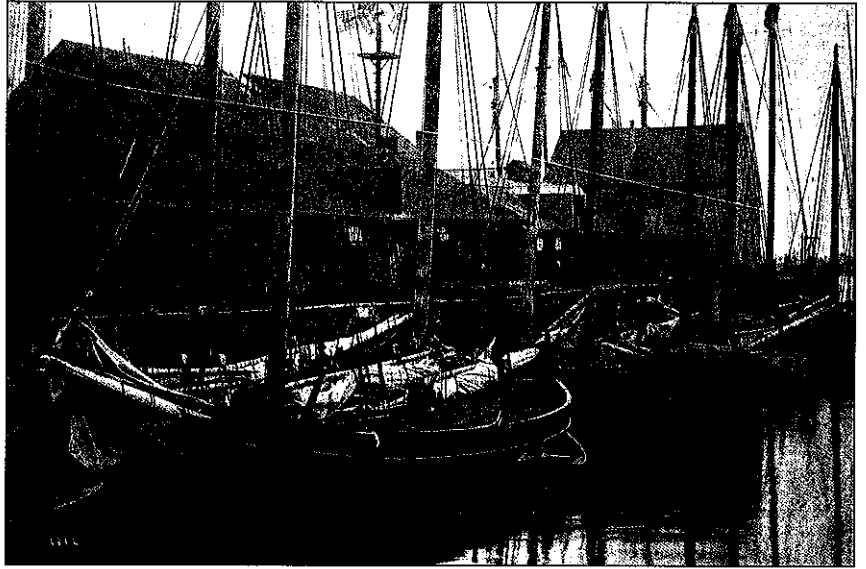
In an attempt to improve groundfish stocks and revitalize the groundfish industry, the state of Maine formed a Groundfish Hatchery Commission to study the possibility of establishing one or more hatcheries for cod and other commercial species of groundfish.

The commission concluded that, while it was feasible to establish a groundfish hatchery, it was not practical to stock groundfish for a "put and take" fishery that would directly increase catches. However, if hatchery production could be used to increase the number of active spawning sites along the coast, spawning success would be greatly enhanced. This in turn, would drastically reduce the recovery time of over fished stocks.

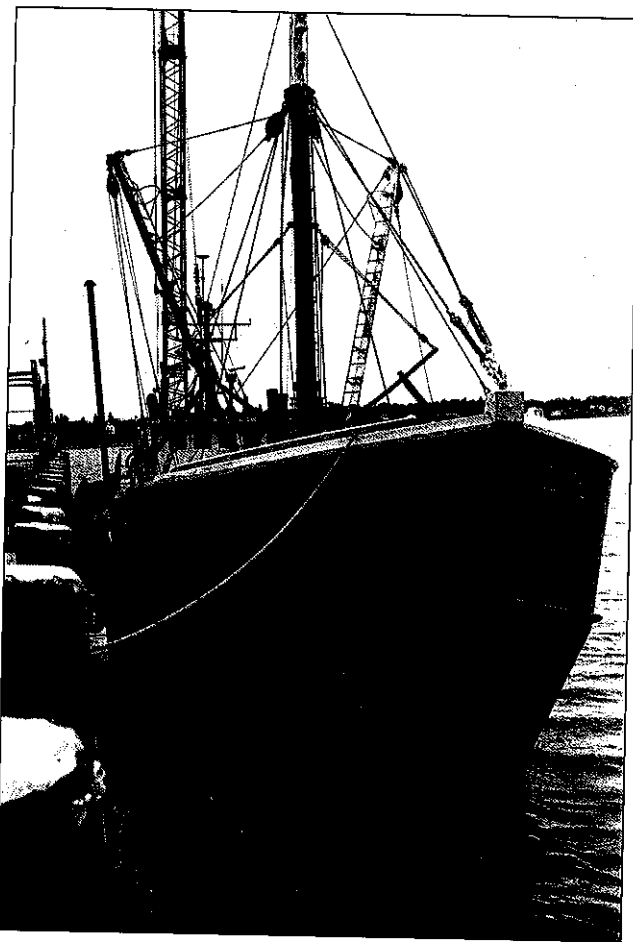
The commission recommended that young cod and haddock be released in the vicinity of formerly productive spawning grounds and nursery areas in order to "jump start" them into renewed production.

These lost spawning areas represent a huge area of ideal habitat for groundfish. Unfortunately, most of the inshore grounds that could be used for such a project were "fished out" decades ago and have long since been abandoned by fishermen. Today, few fishermen remain that know where these inshore spawning grounds are to be found. Locations were not recorded. Had this attempt not been made, the information would have been lost.

By interviewing older fishermen, many spawning areas for cod and haddock between Grand Manan Channel and Ipswich Bay have been identified. The survey uncovered extensive spawning areas in the northern half of the Gulf of Maine within Maine's coastal waters that were previously unreported. It also revealed a number of other factors relating to the depletion of cod and haddock throughout the GOM.



Fishing fleet at Fernald and Dyers wharves, Portland, 1882. (Frank Claes collection)



Fishing boat docked at Portland Fish Pier, 1993. (Bob Moore photo)

METHODS AND PROCEDURES

A procedure outlined in "Recording Living History", (E. Ives, 1980) was used as a guideline for the interviews. A list of retired fishing captains and older active captains who were well known for their ground fishing success in the inshore waters of the Gulf of Maine was prepared by the Maine Gillnetters Association and Maine Fishermen's Cooperative Association.

Tapes were reviewed and locations recorded, tabulated, and plotted on appropriate nautical charts. Two criteria were used to classify a location as spawning ground: (a) the site had to be independently confirmed by two or more references, or identified by a single reference and in the immediate vicinity of a confirmed area; and (b) the appropriate substrate and depth of water for spawning had to be present.

Captains who used the prevailing technology of otter trawling frequently did not differentiate between adjoining pieces of bottom with the result that several of the fishing grounds mentioned by Rich, 1929, were often described as one. While considerable effort was made to identify individual grounds (Appendix A), locations were determined directly from plots made on navigational charts wherever possible.

Appropriate charts were prepared for computer display by the James W. Sewall Co., Old Town, Maine. Spawning locations were placed into a geographic information system (GIS) format by Scott Dickerson of the Island Institute. Spawning ground area was then calculated.

RESULTS

Spawning Grounds From Grand Manan Channel to Monhegan

The survey of areas from Grand Manan Channel to Monhegan identified a total of 140 relatively small, discrete spawning grounds and nursery areas, including 133,390 acres of spawning ground for cod and 133,788 acres of spawning ground for haddock. The total spawning area for cod and haddock between Grand Manan Channel and Monhegan, counting overlapping spawning areas separately, was 247,178 acres, or approximately 386 square miles.

Of the 140 locations, cod were reported in 83 sites and haddock in 100 sites, with 43 sites where both species were present. Of the total, 85 were confirmed by two or more contributors and 55 were reported by one contributor and in close proximity to confirmed locations. All areas were reported to have appropriate substrate.

East of Petit Manan, 23 spawning locations were reported: 15 were confirmed by two or more fishermen and eight by one. Between Petit Manan and Isle au Haut, 58 grounds were reported, 37 of them confirmed by two or more fishermen and 21 by one; between Isle au Haut and Monhegan, 59 grounds were reported by two or more fishermen and 26 by one.

Table I. Estimated Spawning Area From Grand Manan Channel to Monhegan (in acres)

<u>Location</u>	<u>Cod</u>	<u>Haddock</u>	<u>Overlapping</u>
Grand Manan Channel Area	2,521	175	10,959
Machias Bay Area	8,528	3,154	1,147
Frenchmans Bay & Schoodic Bay Area	3,196	2,260	2,432
Blue Hill Bay Area	1,258	1,986	14,327
Jericho Bay Area	1,937	1,428	7,253
Penobscot Bay Area	13,007	41,270	46,695

Note: In the eastern section of the Gulf, most reported spawning areas were within three miles of shore. Few of these areas had been identified previously.

Spawning Grounds From Monhegan to Ipswich Bay

The western portion of the survey identified a combined total of 41 spawning grounds and nursery areas. Cod were reported at 25 sites and haddock at 19 sites; there were three sites where both species were present. Of the total, 34 sites were confirmed by two or more contributors, and 7 were reported by one. All areas were reported to have appropriate substrate. A nearly continuous strip of inshore spawning ground for cod and haddock extends from Casco Bay to Ipswich Bay, most of which is found relatively close to shore. Though many of the locations reported in the western portion of the Gulf of Maine have been previously identified (Bigelow & Schroeder, 1952), the total area reported in this survey is more extensive than earlier reports indicated.

Table II. Estimated Spawning Ground Area From Monhegan to Ipswich Bay (in acres)

<u>Location</u>	<u>Cod</u>	<u>Haddock</u>	<u>Overlapping</u>
Muscongus Bay	--	--	4,815
Sheepscot Bay Area	1,206	--	--
Casco Bay Area	7,630	6,238	66,321
Saco Bay Area	9,865	--	65,103
Wells Bay & Boon I Area	6,897	11,969	--
Ipswich Bay Area	44,560	10,399	--
Jeffreys Ledge Area	27,768	8,733	17,146

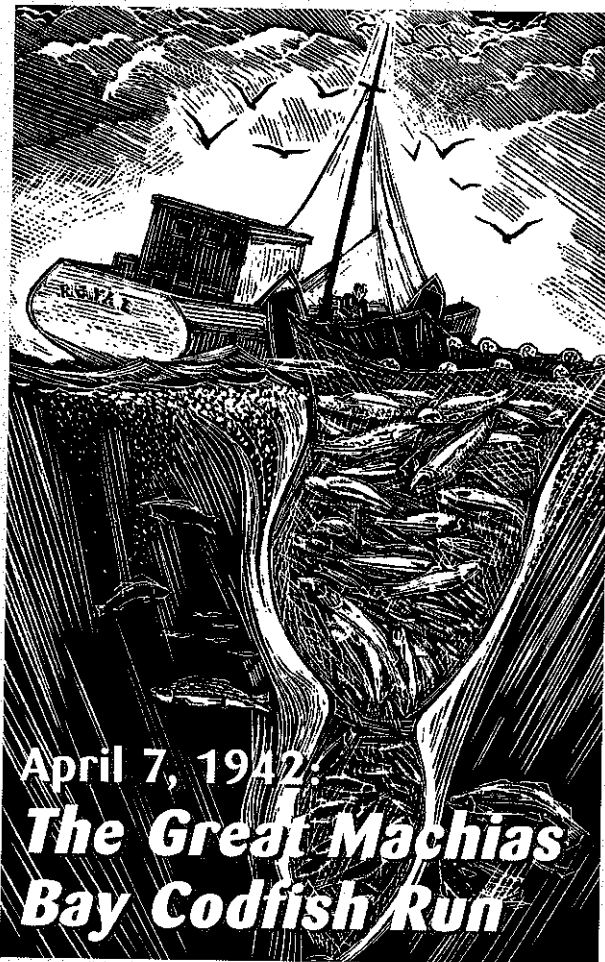
Total Spawning Area

In the western portion of the study, fishermen reported a total of 251,311 acres yielding ripe or spawning cod and 185,676 acres yielding ripe or spawning haddock. If overlapping spawning areas for cod and haddock are counted separately, the area between Monhegan and Ipswich Bay, included 436,987 acres (approximately 682 sq. mi.) of cod and haddock spawning ground.

Total Spawning area From Grand Manan Channel to Ipswich Bay was compared. Spawning areas for cod and haddock were compared. Sixty-three percent (673 sq. mi.) of the surveyed grounds were located in the western part of the study area and 36 percent in the eastern portion. A total of 684,160 acres (1,069 sq. mi.) of GOM coastal waters were reported to have produced ripe or spawning cod and haddock.

Cod spawning areas totaled 364,701 acres (570 sq. mi.), with 59 percent, (336 sq. mi.) located in the western part and 41 percent, (234 sq. mi.) in the eastern part.

Haddock spawning areas totaled 319,459 acres (499 sq. mi.), with 58 percent of the total (289 sq. mi.) located in the western part and 42 percent, (210 sq. mi.) in the eastern part.



April 7, 1942:
**The Great Machias
 Bay Codfish Run**

By Edward P. Ames

Memories of this region's lost bounty are like glimpses of something out of the corner of your eye — when you turn to look, they're gone. Had there really been something there, or did we only imagine it? Were the stocks of fish that used to inhabit Maine's coastal and offshore waters really all that plentiful?

Old landings records show only modest landings for coastal waters, but according to W. H. Rich in his *Fishing Grounds of the Gulf of Maine*, these records show "only a fraction of the catch, since they deal entirely with the fares of fishing vessels of 5 tons and over."

Maine's coastal grounds were home turf to the state's fleet of smaller boats. "There are literally thousands of the so-called under-tonned boats that take millions of pounds from these waters annually, principally cod and haddock," Rich writes. In 1923, in Portland alone, these boats had landed more than three million pounds of groundfish.

Reports from fishermen of the period paint an

Table III. Estimated Total Area of Spawning Grounds From Grand Manan Channel to Ipswich Bay (in acres)

E Cod spawning areas	113,390
E Haddock spawning areas	<u>133,788</u>
Combined Eastern Part	247,178
W Cod spawning areas	251,311
W Haddock spawning areas	<u>185,671</u>
Combined Western Part	436,982
Total Eastern & Western Parts	684,160

DISCUSSION

The interviews have yielded subjective, anecdotal data that has been difficult to validate. The recollections of an elderly fisherman about fishing activities that occurred over a half century ago have to be confirmed by corroborating interviews. Precise dates have been difficult to determine and because modern navigation devices were often not available, exact locations have sometimes had to be estimated.

Fishing is by nature a secretive business. Knowing where to fish at different times of the year determines one's financial success. Fishermen who have spent a lifetime hoarding information about the grounds they fished have a natural concern about sharing the specifics.

On the other hand, the sites identified in this report were where fishing could be conducted effectively and, depending on how the fish were caught, do not necessarily represent the only spot in an area where fish were spawning. In many instances additional bottom of apparently suitable composition was present and may indicate that more extensive spawning areas existed.

Throughout the study area, fishermen reported that inshore spawning areas for cod and haddock were located where patches of gravel or sandy substrate coincided with depressions and tidal eddies. These sites were either channels or basins ranging in depth from 30 meters to 100 meters and had either a gravel bottom or a mud bottom with gravel/sand along the sides.

The relationship between substrate, eddies and cod/haddock has not been thoroughly studied.

The eddies may serve to entrain eggs and larvae over critical habitat providing shelter for post-larval juveniles, thus enhancing their survival. Current velocities associated with these eddies may distribute substrate particles in such a way that the proper habitat for juvenile cod and haddock to use for shelters is created.

Clearly a more detailed study of bottom and current characteristics and their effect on the behavior of groundfish eggs and larvae is needed.

Unlike Georges Bank and portions of western Gulf of Maine, where great expanses of sandy bottom prevail, the shape of the bottom bordering much of coastal Maine is very irregular, with intermittent patches of mud, sand, and gravel dispersed amongst larger areas of hard, rocky bottom. While the average distance from shore to a depth of 50 fathoms is probably 20 miles, the bottom is so irregular that depths much greater than that can be found close to shore.

This bottom pattern has created many small, relatively isolated spawning areas, particularly in the eastern half of Maine. The discrete nature of such spawning areas, where located close to shore, allowed them be easily over-exploited or polluted.

Behavior of Gulf of Maine cod and haddock

After moving from one site, a number of fishermen noted, cod and/or haddock would often arrive at another location close by. During the interviews, several such examples involving fish movements were noted. Many fishermen base their fishing strategy on what they believed these movements (or migrations) to be.

Though cod, in particular, have been reported to migrate great distances, substantial numbers of resident fish apparently did not. Instead, they simply moved to adjacent deep water basins where they remained until the beginning of the following spring's spawning run. Wintering grounds for cod and haddock stocks along the Maine coast were the channels and basins of the coastal shelf, particularly those leading to the major basins of the Gulf.

There is some evidence to suggest that areas such as Penobscot Bay may have serviced two stocks of fish: a resident stock that appeared inshore

APRIL 7, 1942

even more impressive picture. One such report surfaced last winter while I was researching historic cod and haddock spawning grounds in the Gulf of Maine: the "Great Machias Bay Cod Run."

This event is supposed to have occurred just outside the harbor of Jonesport, Maine, where large schools of giant codfish were discovered by a dragger at the entrance of Machias Bay as he prepared to go fishing to the "west'ard."

The legend goes something like this: after towing his net for a short while just outside Jonesport harbor, the skipper hauled back. To his surprise, his net was filled with giant cod averaging over five feet in length. The net held so many fish that he couldn't hoist them aboard. So he strapped the net to the side of the vessel and towed it back into the dock to let it ground out on the ebb tide. When the tide was low enough, he emptied the net by (depending on who tells the story) either loading trucks or hoisting it back over the side.

And set off a great fishing bonanza.

I'd heard the story before, but had always taken it with a grain of salt. The idea that a large school of giant cod could have survived in an area that had been heavily fished for hundreds of years seemed to stretch the truth a little bit too far. Until last winter, that is, when William "Killer" Smith, an old fishing colleague of mine from Jonesport, took me to interview Roger Beal, Sr., a retired fisherman. Roger (I hoped) would tell us about some of the old cod and haddock spawning grounds that used to exist in the area.

Roger finally put the issue to rest. The Machias Bay spawning run of giant cod had actually happened.

Roger had been fishing that winter with his father, John Beal, captain of a new sardine carrier-dragger, ROYAL. They had discovered the spawning run, and he shared the adventure with us.

During the winter of 1941-1942, dragger fishermen throughout Maine were having a banner year. The country had just shifted into a wartime economy, and fish prices were sky high. The Gulf of Maine redfish fishery had just begun and any boat big enough to tow a net was rushing to convert to dragging.

The 74-foot ROYAL was launched in Thomaston late in 1941. As soon as she was ready, Captain John Beal and his son Roger brought her back to Jonesport. In a short while the new carrier was transporting herring to the company's Yarmouth factory.

APRIL 7, 1942

All had gone well until one day when the ROYAL pulled into the wharf, her decks awash with herring, to find the factory "burned flat to the ground." It was a serious matter, for until the factory could be rebuilt, there was no longer a need for the new sardine carrier.

Instead of leaving their brand-new carrier sitting idle during reconstruction, the owners decided to join the redfish bonanza. John and Roger were directed to take the ROYAL to Portland to be rigged over for dragging. The ROYAL could be switched back to carrying herring later on.

By early winter they were towing for redfish.

"I hadn't fished too much before that," Roger recalled. "We were fishing out of Vinalhaven for redfish that winter. There was fairly good fishing around there, oh, about an hour's steam outside Matinicus," said Roger. "But my wife, Buelah, got sick... phlebitis in her leg, you know. I had to come back to Jonesport to help take care of her. So we came back and tried to make a living around here until she got better."

In the Jonesport region, the usually plentiful cod and haddock normally left the shore soundings during the fall, backing offshore into deep water until spring. The winter of 1941-1942 was no different. Fish were scarce around home.

"Most every time we went out, we'd make a tow along that bottom just east of Mark Island. We'd start off... oh, off about where Libby Island touches the second notch on Cross Island and then run right for the light. Got a handful of fish, you know. Just barely enough so you'd try it again some other day, but not enough to bother setting back."

The ROYAL settled in for the winter. Fishing became reduced to occasional cold, brittle forays into the bay whenever a clear day punctuated the tedious march of storms. Foul days were often used to work on gear. But even gear work has its limits.

"We'd built up a new net on blowy days while we were waiting, and we were getting anxious to go back to the west'ard and go red-fishing again."

Eventually, inexorably, winter wore itself thin.

"Buelah was slow getting better, but she was gaining. By the end of March, we figured it wouldn't be much longer. Well, come morning, April seventh, we run out to the tow and hove the gear over. We dragged for about 20

in March, April and May to spawn locally, and a second stock that appeared in June, July and August that had spawned elsewhere and were in the area to feed (Perkins, 1996). It is the resident spawning stock that has disappeared from Maine inshore waters.

Two comprehensive surveys of fishing grounds within the Gulf of Maine have been made (Goode, et al, 1889; Rich, 1929). The fishing grounds listed in these surveys were often fished by the interviewed fishermen during appropriate seasons, but many of them did not produce ripe cod or haddock. Instead, most of the spawning areas reported were located inshore of the fishing grounds, where they provided good catches of spawn fish until stocks disappeared.

It is tempting to suggest that many of the fishing grounds reported by Rich were feeding and gathering areas for cod and haddock moving to or from the spawning areas identified in this report. Returns from recent tagging studies (Perkins et al, Maine Dept. of Marine Resources) support this reasoning.

Factors Contributing to the Collapse of Coastal Stocks

Coastal pollution may have rendered some inshore spawning areas uninhabitable for the fish. There is good evidence that such was the fate of grounds in upper Penobscot Bay. A similar pattern of disappearance was noted, however, in unpolluted areas such as Machias Bay, Little Machias Bay, the open bay surrounding Nash Island, Frenchmans Bay, Blue Hill Bay, and Jericho Bay.



Baiting up at Boston's T Wharf, 1890 (Frank Claes collection)

By the same token, limited migrations to adjoining deeper water left stocks of cod and haddock particularly exposed to otter trawling and gill-netting. Pre-spawning aggregations have been routinely harvested during the fall and winter along the entire length of the area studied and, since 1945, have been fished at depths of greater than 200 meters.

Unfortunately, while over fishing can explain the collapse of cod and haddock stocks, it fails to adequately explain why, when stocks farther offshore were recovering, Maine's coastal stocks did not. Many inshore spawning grounds that, even where water quality is adequate, have remained barren since the initial disappearance of haddock and cod. Some grounds have been abandoned for more than 70 years, even though they adjoin areas with cod and haddock. Clearly other factors affecting cod and haddock stocks have prolonged their absence from these ideal habitats.

It is notable that the collapse (and recovery) of cod and haddock stocks in Maine's inshore waters was aggravated by an inability to recolonize their former grounds. Recent studies suggest why.

It has been assumed that eggs and larvae carried by current patterns within the Gulf of Maine should re-populate the whole region. However, recent work (Pettigrew, 1996) shows the presence of multiple gyres that could restrict the movement of eggs and larvae between Eastern Gulf, Georges Bank, and Western Gulf.

It has also been reported that the Maine Coastal Current insulates coastal waters inside the 100 meter contour from central Gulf waters (Holbroke and Lynch, 1996). This would be particularly apparent east of Penobscot Bay where large tides induce complex eddies and currents around the numerous islands and deep bays and, to a great extent, are noticeably distinct from offshore waters.

Such conditions would tend to make it difficult for coastal areas to receive eggs and larvae from Gulf circulation. In a similar manner, eggs released inshore in Eastern Maine waters would be less likely to drift into the Gulf gyre and would tend to remain inshore. If, in fact, coastal stocks of fish depended on eggs released into inshore waters to maintain

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minutes on the marks and hauled back. We had about 10,000 pounds of cod on that tow. But those codfish were all over five feet long! I don't know where they ever came from, because they weren't there the day before. We split the bag and heisted them aboard. No problem with the first tow. Everything worked fine. But we knew that the old net probably wouldn't stand another tow like that. So we run back into the harbor to Charlie's Crick and put on the new net. We kept the old bull rope. [A bull rope is a heavy line with a small loop in each end that goes along the outside of the net from the front to the cod end at the back.] When we rigged the cod end, instead of changing it, we just run the new splitting strap through the eye of the old bull rope and went back out again. As it turned out, we shouldn't have.

"We run off the marks and set back out and towed for about an hour and 20 minutes. This time when we hauled back, you could see the net coming a long way down."

The ROYAL was an eastern-rig; the net and trawl doors were mounted on one side of the vessel. When the captain hauled back, he would lay the boat downwind to help keep the net away from the propeller. This made the vessel drift away from the net while tending the gear and taking the fish aboard. But if you looked down over the side as the net was being pulled up, you were looking right into its mouth.

As Roger watched the net loom into sight, it appeared large and luminous white, and he knew at once it was the reflection of more giant codfish being drawn from the depths toward the boat.

"It looked like a big white ball coming! All you could see was a big white ball! And the whole net was filled from the cod end right to the mouth with those big codfish!"

Finally the trawl doors were hauled into the galuses and the net hung alongside. The Beals worked fast to keep the big catch from swimming and floating back out the mouth of the net.

In an instant Roger had taken the jilson, a line running through a block in the rigging with a small iron hook spliced in one end, and hooked it into the middle of the heavy roller section. As he did, his father took a few turns around the winch head and slowly hoisted the heavy rollers aboard.

Now the giant cod were safely trapped. Now the fishermen were ready to start hoisting fish aboard.

Excitedly, Roger unhooked the jilson from the

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rollers, untied the bull rope from the net and slipped the jilson hook into its loop. His father hoisted again; hauling the manila bull rope in until it drew tight around the submerged net at the top of the cod end. Slowly, as the splitting strap began to draw tight, the cod end was pinched off from the rest of the net. Excess fish slid forward into the belly.

As the cod end was lifted higher, a bulging bag of fish slowly emerged from under the loose twine and squished heavily against the side of the ROYAL. Finally it swung aboard. Roger reached underneath the massive, swinging bag and grabbed the tail of the pucker string. He yanked hard to untie the knot and jumped aside as several thousand pounds of cod spilled out into the deck checkers.

Quickly retying the cod end knot, Roger pushed the empty bag toward the side and guided it back overboard as it was lowered. Once the net was back in the water, his father steamed the ROYAL in a circle to wash more fish back into the cod end. When it was filled, he kicked the engine into neutral and hauled the next bag of fish aboard.

"We got two heists aboard before the bull rope parted," Roger recalled, "Then, it let go. When it did, the cod end just hung straight down over the side, underwater. The splitting strap was on the cod end, so it was underwater, too. So we couldn't reach the splitting strap to rig a new one. By then it'd started to breeze up from the sou'west. And you know sou'west is out there . . . Well, we couldn't do nothing so we strapped the net to the side and towed it all the way from Libby Island into the crick down below the house, here.

"When the tide dropped enough so's we could get at the splitting strap, we hooked in the jilson.

"They were some heavy, too," Roger went on. "I was winchman and when I took a strain on the bag, you could see it was gonna be too big to heist. We had a 60-horse Kermath on board for a donkey engine and that thing was turned right up. When he said, 'Put an extra turn on the winch head and come back on her,' I did.

"Well, that hook on the end of the jilson straightened out and shot up into the rigging like a cannon! It's a wonder it didn't kill somebody. After that, we took them aboard in smaller heists."

"We had to split them three more times before we finally got them aboard. We'd towed them in so hard they were packed solid. Best as I can figure,

their populations, it would partly explain why, once those stocks disappeared, the grounds were not repopulated. Once fished out, they could not recover because there were no eggs.

Reports indicate that once an inshore spawning ground lost its resident population, it remained barren during spawning season even when populations of spawning cod and haddock were present on neighboring grounds.

Cod and haddock were often reported in areas close to abandoned spawning grounds at various times of the year, but they did not use them for reproduction. Instead, they (apparently) returned to their own spawning ground, even though the area they were leaving had suitable spawning areas.

Spawning migrations or "runs" of cod and haddock to specific spawning grounds are well-documented in the GOM (Earle, 1880, Perkins, et al, 1996) and formerly occurred in every major bay studied. It is the fidelity of inshore populations to specific runs that is notable. Such fidelity suggests that Maine's inshore stocks of cod and haddock behaved much like salmon and may have existed as discrete populations that took part in annual spawning runs to their individual spawning grounds.

CONCLUSION

Until the recent past, coastal waters of the Gulf of Maine once supported robust fisheries for cod and haddock. This study was able to document the location, character, and extent of present and former spawning areas for these species between Cape Ann and Bay of Fundy. Because a number of spawning areas were relatively isolated, the sequence and nature of their collapse also provided an insight into how those cod and haddock populations functioned.

Anecdotal evidence from fishermen indicates that Maine's coastal stocks of cod and haddock are composed of many discrete stocks that mix freely with other stocks during parts of the year; but, as spawning season approaches, return by specific routes to their own separate spawning locations. Such observations are supported by the results of recent tagging studies of cod in coastal Maine and new discoveries about the Gulf of Maine's circulation patterns.

These observations and discoveries challenge

the prevailing assumption that cod and haddock are Gulf-wide populations with few distinct subgroups, and suggests why some current management strategies may have failed.

Siri Beckman illustration



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there was about 30,000 pounds in that tow."

The very next day on the first tow, they hauled back yet another huge net of fish. Once again they broke the bull rope; again they had to tow the net back to the harbor; this time towing it to Layton's Wharf.

Total time fished: about three hours. Total pounds landed: between 80 and 90 thousand.

This was no stray school of fish.

When they returned to Libby Island Sound, two draggers from Portland had arrived. It hadn't taken long for the word to get out. Soon a formidable fleet gathered to fish on the giant cod.

The spawn fish, the draggers soon discovered, were not only filling Machias Bay, but were also abundant all the way from below Moose Peak Light in the west, to the south of Cross Island.

The end was predictable. The fish lasted through the spring of 1942. The following spring, even more vessels arrived, but caught fewer fish. By the third year, the spring run of giant Machias Bay codfish was broken. The bonanza was over.

My survey has been concerned only with the actual locations of former and current spawning grounds. But in the process of talking about these locations, many similar tales about cod and haddock abundance were told. In fact, every major bay studied (to date) has suffered a fate similar to the Machias Bay cod.

In one sense, it's sad to come across such stories. Sad because these stocks of fish are gone and we are clearly much the poorer.

But there's an exciting opportunity here, too. Such reports of abundance suggest that with an appropriate recovery plan, these stocks could be restored.

Spawning areas around places like Machias Bay and Penobscot Bay could be revived and protected, to regain a vast marine treasure that would give us all a truly sustainable fishery.

For those who would take care of it.

A commercial fisherman and marine scientist, Edward P. "Ted" Ames has taken part in the Gulf of Maine region's marine policy debates for nearly 20 years. During 1996, he served as Marine Resources Director at the Island Institute.

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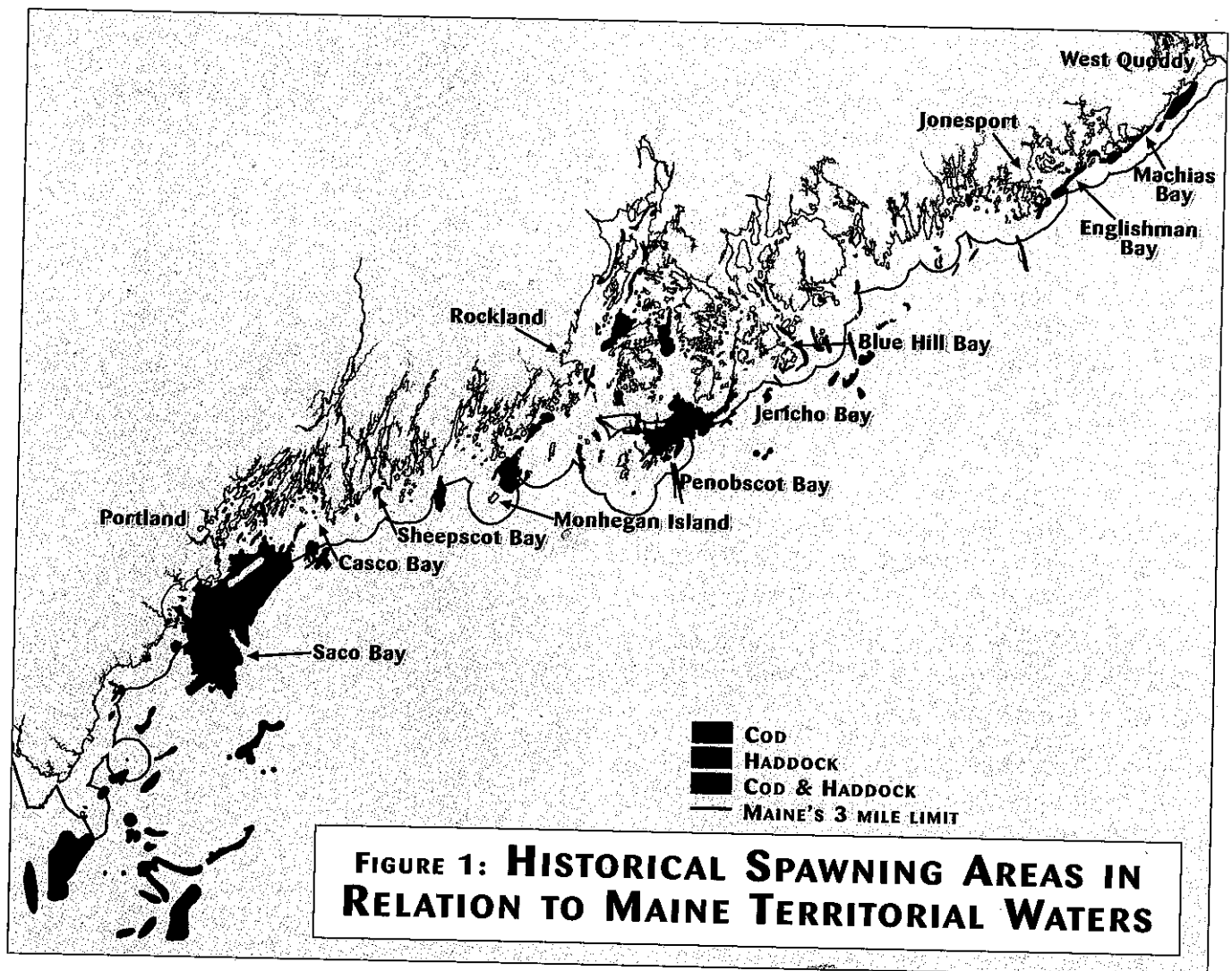
AN ATLAS OF COD AND HADDOCK MAPS





INCLUDING SPAWNING GROUNDS AND DETAILS OF PENOBSCOT BAY

The following images and maps demonstrate some of the spatial relationships between historic spawning grounds and other features of oceanographic and benthic interest.

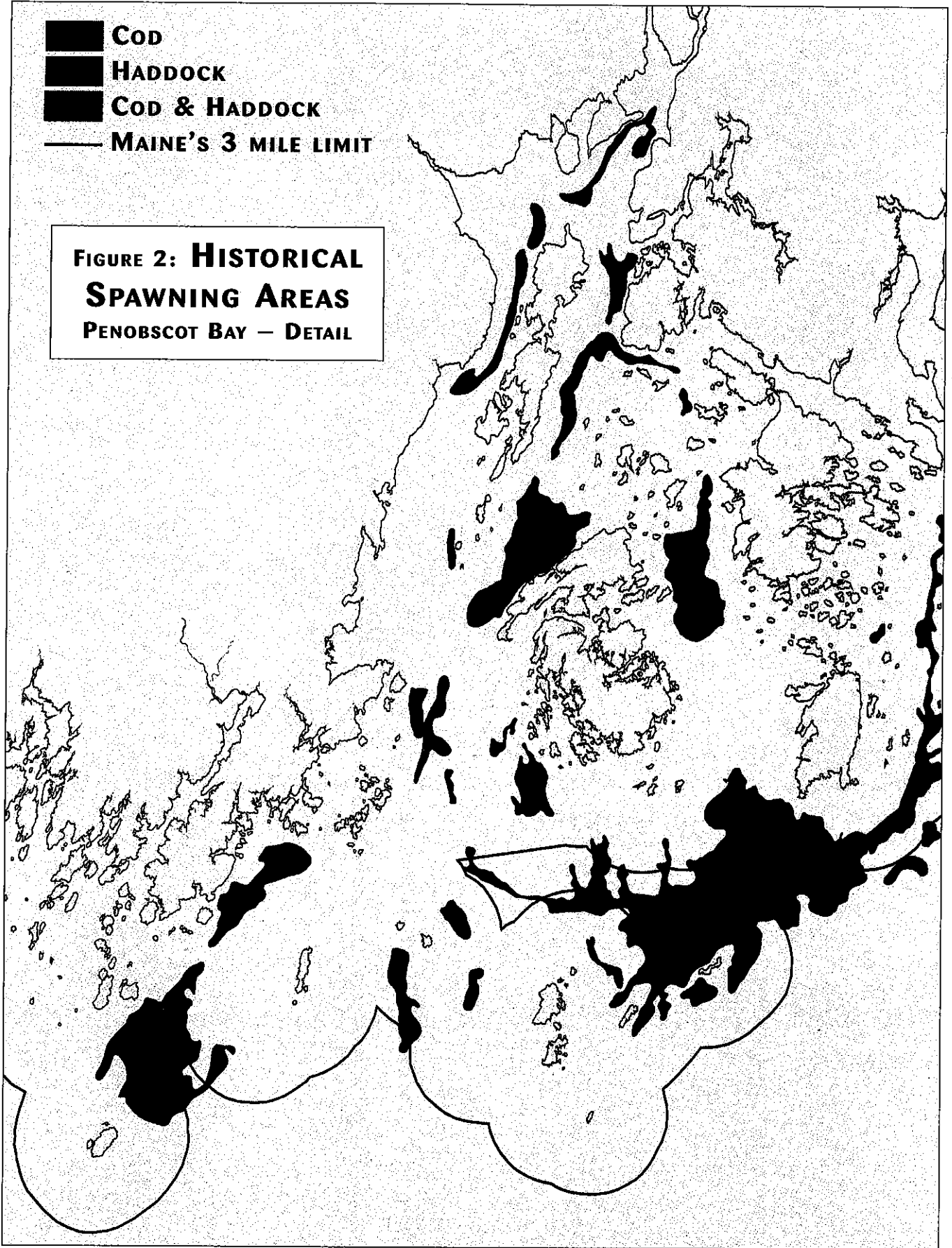
Figure 1 (below) shows cod and haddock historical spawning areas (Cape Ann to West Quoddy Head) in relation to Maine's Territorial Waters. This map was entered into a Geographic Information System (GIS) from the charts compiled by Ted Ames during his interviews with fishermen. It highlights clusters of large spawning grounds along the inshore portions of the part of the Gulf of Maine in Eastern Maine between Jonesport and Lubec, as well as very extensive grounds at the outer edge of Penobscot Bay and up into East and West Penobscot Bay, with smaller spawning grounds off Monhegan. The largest cod and haddock spawning grounds in the study area, however, were once located off Casco and Saco Bays.

Figure 2 (facing page) details cod and haddock spawning grounds in Penobscot Bay, showing large grounds south of Isle au Haut and Vinalhaven and others leading from Monhegan to the entrance of the Muscle Ridge Channel. Very important spawning grounds were found off North Haven, off Castine, off both shores of Islesboro and all the way north to where the Penobscot River enters the bay at Cape Jellison and Sandy Point.



-  COD
-  HADDOCK
-  COD & HADDOCK
-  MAINE'S 3 MILE LIMIT

**FIGURE 2: HISTORICAL SPAWNING AREAS
PENOBSCOT BAY — DETAIL**



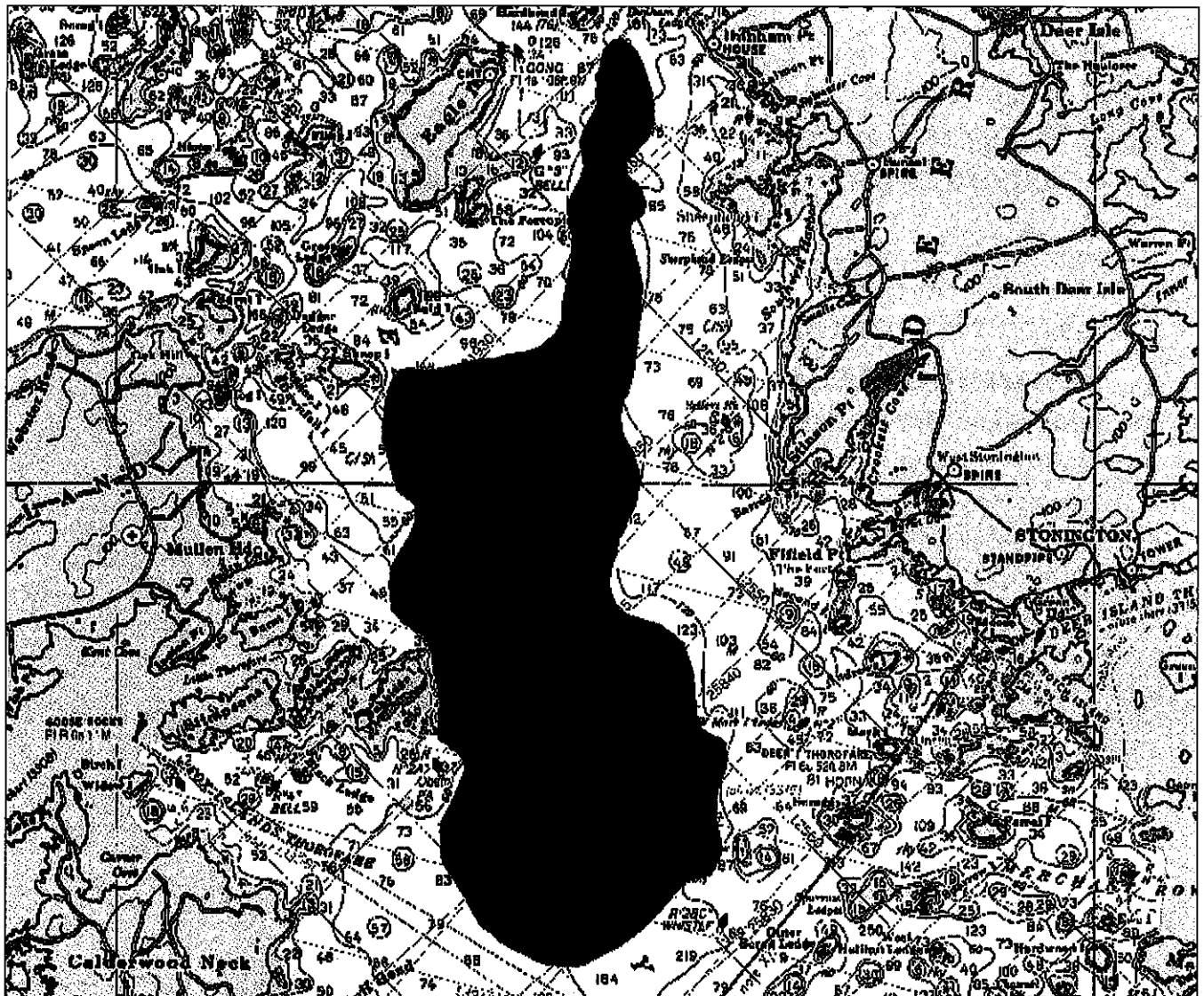
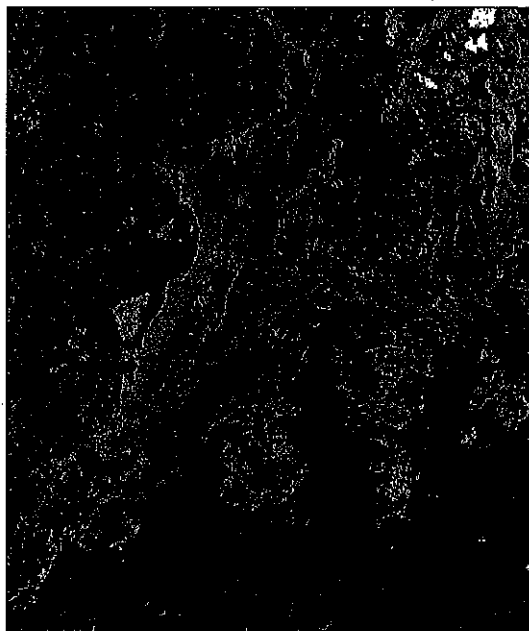


Figure 3 (above):
 The GIS plot of Ames's spawning ground data on an electronic chart showing bottom depths. This large cod spawning ground where "ripe and running" fish were taken is located in a deep water channel of the Bay where currents run fast. (Electronic chart: J. Sewall and Co.)



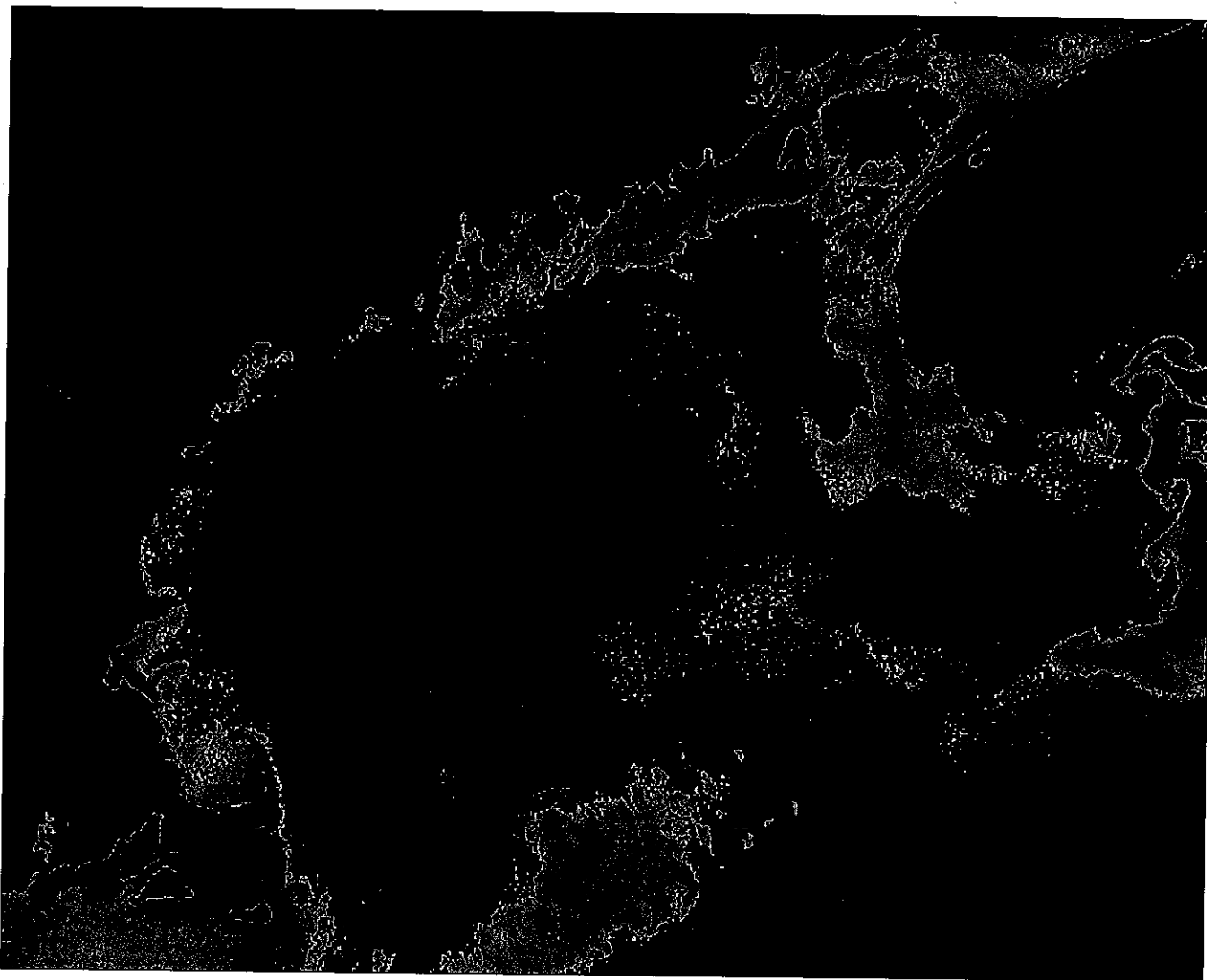


Figure 5 (above): This ocean color image taken in June by the Coastal Zone Color Scanner shows the plankton bloom of the middle portion of the Gulf of Maine. The bloom, the most intense portions of which are illustrated in green and purple, originates off Grand Manan (nourished by a nitrate-rich upwelling), spreads southwestward on the Eastern Maine Coastal Current, and progresses along the entire coast of Maine. The bays of Maine from east to west act like catchment basins for this bloom of primary productivity with its associated larvae. Intense but smaller blooms are shown in Machias, Englishman and especially eastern Penobscot bays between North Haven and Deer Isle, the location of a deep water channel that was once an important cod spawning ground. Image processing by R. Podolsky and P. Conkling.

Figure 4 (facing page, bottom) is a pair of satellite images detailing Penobscot Bay, showing surface thermal patterns on an incoming tide from Landsat images, June 27, 1995, and August 18 of the same year. The coldest waters show in magenta and dark blue; warmer waters are light turquoise.

These patterns are indicative of circulation features in the bay. Cold waters, presumably nutrient-rich, intrude from offshore and completely surround the islands of Swan's (at the eastern edge of the images), as well as Isle au Haut, Vinalhaven and North Haven islands, while Islesboro in the upper Bay is surrounded by warmer waters. By August, colder waters are more restricted in their extent and appear off Swan's, Isle au Haut, the western shore of Vinalhaven and along the outer edge of the Muscle Ridge islands at the lower left hand corner of the images. Cold waters also persist in eastern Penobscot Bay, suggesting that a localized upwelling there continues to bring cold, nutrient-rich waters to the surface. This is the same area that Ames identified as a major cod spawning ground. Image processing by Deirdre Byrne.

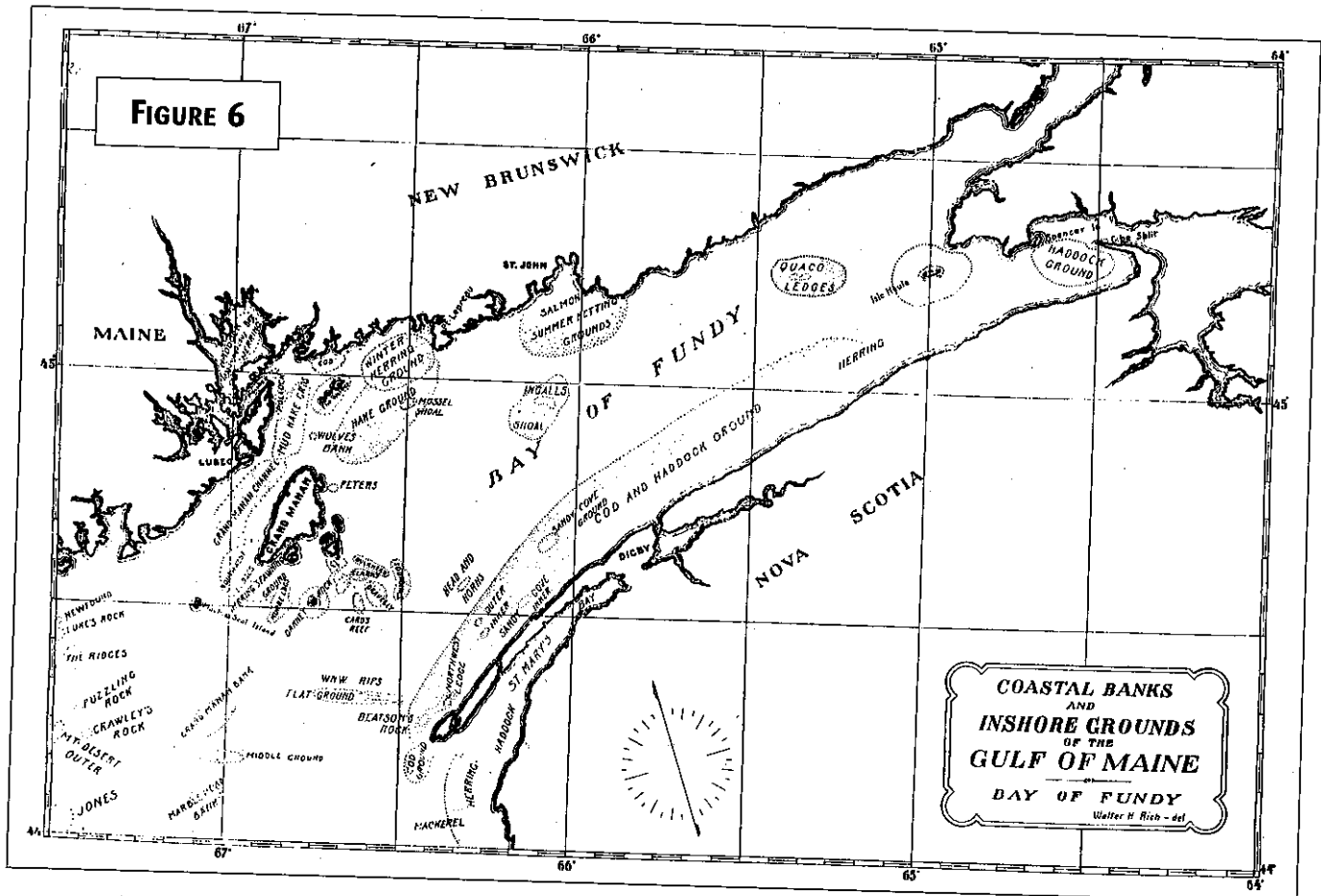
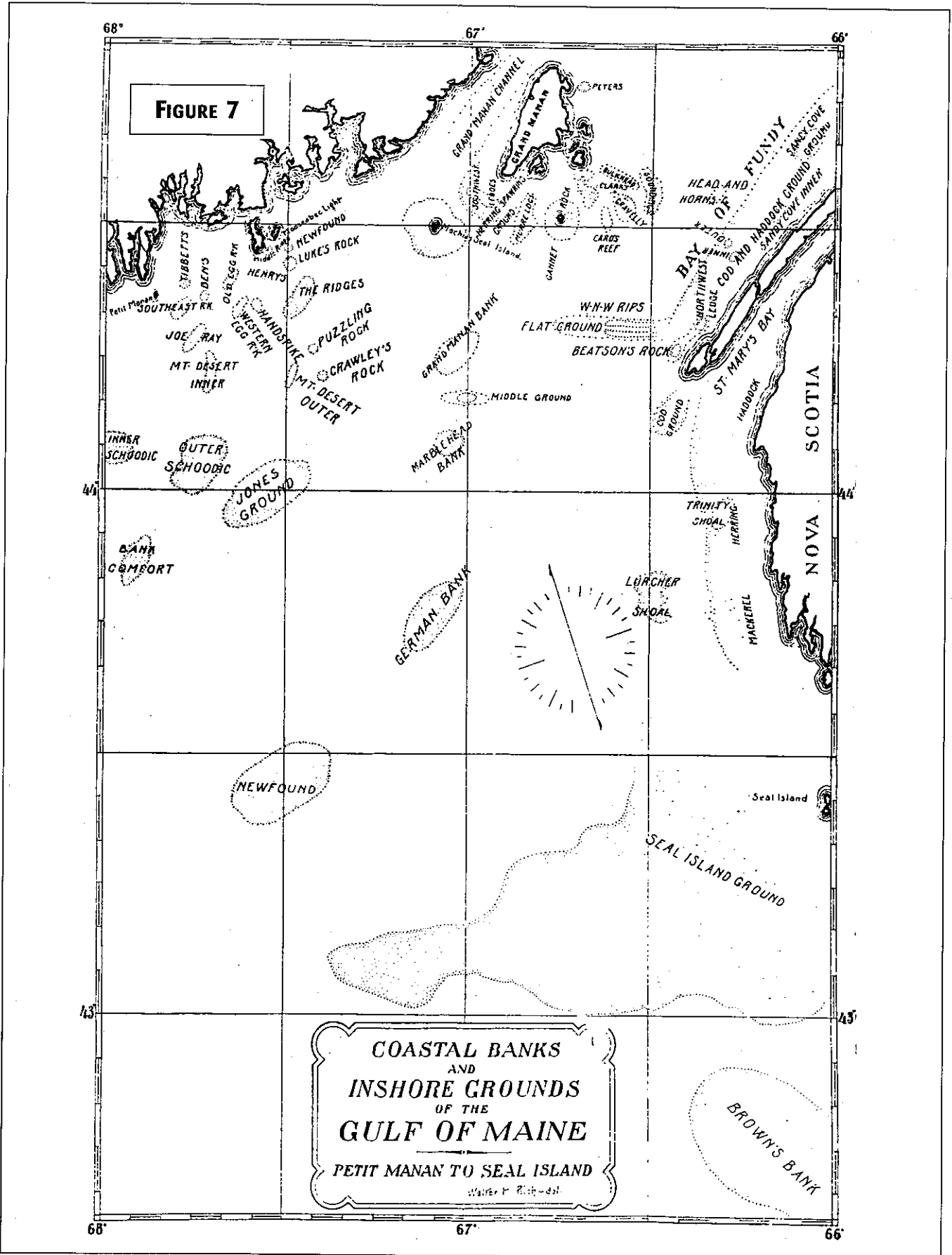


Figure 6 (above) shows the large and important grounds in the eastern Gulf of Maine between Grand Manan and Eastport-Lubec. This information was assembled by Walter Rich using Goode's maps as a reference. The Nova Scotian cod and haddock grounds spanned nearly the entire north shore of that province. The Isle au Haut grounds in the inner Bay of Fundy were actually first discovered by Isle au Haut fishermen early in the 19th century and underscore the historical connections within the entire inshore fishery.

Figure 7 (facing page): This map by Walter Rich shows mostly smaller fishing grounds, including Inner and Outer Schoodic off Petit Manan and Middle Ridge, Handspike and Jones Ground off Jonesport. The ground known as "Bank Comfort" suggests an understanding of the connection between nature and wealth exists in the Gulf of Maine.

Figure 8 (page 24): Rich and Goode's groundfish habitats ("grounds") in the southern and western portions of the Gulf of Maine from Stellwagen Bank off of Cape Cod to Monhegan Island. Note the large winter cod grounds in Ipswich Bay from which truly legendary catches were made through the 1870s on hook-and-line trawls; also the expansive grounds on Jefferies and West Jefferies ledges. In general, the fishing grounds are less scattered as one proceeds south and west into the Gulf of Maine. Cod Ledges, off Half Way Rock, more than 12 miles offshore at the outer edge of Casco Bay, is the innermost fishing ground for Portland – the rest are a good bit further off. Note Inner and Outer Kettle off Southport and Boothbay, as well as Seguin Ground and the Pasture, important local grounds that sustained nearby fishing towns for two centuries. The same point applies to the numerous grounds named for Monhegan, surrounding the island on the west, southwest and southeast.

Figure 9 (page 25) is another Walter Rich map showing groundfish habitats for the middle portion of the Gulf of Maine, including the very large grounds around Cashes Ledge as well as Jefferies Bank, Matinicus Sou'sou', Gravel and Grumpy in outer Penobscot Bay to Shell Ground off Mount Desert Rock. These grounds were fished from Pemaquid and New Harbor on the west; from Friendship and Port Clyde in Muscongus Bay; from Sprucehead, Rockland, the islands and Stonington at the edges of Penobscot Bay to Bass Harbor, Southwest and Northeast Harbors on Mount Desert Island.



HADDOCK & COD SPAWNING GROUNDS

Key: Lg = large; Sm = small

GROUNDS	SEASON				SPECIES	
	Winter	Spring	Sum.	Fall	Cod	Haddock
Cape Elizabeth to Portsmouth						
Wood Island		*			*	
Trinidad		*			*	*
Fire Island		*			*	*
The Pasture		*				*
Sagadahoc		*				*
Doggets	*	*			*	
Tanta	*				*	
Winter Grnd		*				*
Long Hill Grnd	*	*			*	*
Bumbos		*			*	*
Cape Porpoise Peaks	*	*			*	*
Wells Bay	*	*			*	
Lightons	*	*			*	*
Boon Island Rocks	*					*
Blue Clay	*				*	*
Jeffreys, The Cove	*					*
Clay Ridge	*					*
Jerry Yorks Ridge		*			*	*
SE of Jeffreys	*				*	*
W Jeffreys		*			*	*
Scantum		*				*
Ipswich Bay	*				*	
Tower Ground	*					*
Monhegan to Cape Elizabeth						
Seguin		*			*	
Sheepscot River		*			* Lg	
Pemaquid Pt, 40-50 fathoms		*				*
N Upper Kettle	*				*	
Western Ground	*					*
SW of Whistler	*					*
Half-way Rock whistle buoy	*					*
Whole length Casco Bay in gullies along 50f~	*				*	*
Eagle I	*					*
Friendship Ledges off Eastern Pt.	*	*				*
Green I Gully		*			*	*
Inside Aldens Buoy channel-Cape Eliz.	*					*

HADDOCK & COD SPAWNING GROUNDS (continued)

Key: Lg = large; Sm = small

GROUNDS	SEASON				SPECIES	
	Winter	Spring	Sum.	Fall	Cod	Haddock
New Ledge (NE)	*	*	*		*	*
(SW)	*	*			* Lg	
Hue and Cry to Cape Eliz		*				*
Broad Sound						
outside Green I Buoy		*				*
Sand Gully		*				
Hussey Sound towards Long I.		*				*
N side Cliff I. towards Grn. I.		*				*
Outside sand I..		*				*
Winker Ground		*				*

Penobscot Bay and Approaches, including Monhegan

Upper Penobscot Bay

Red Buoy off Lincolnville		*			*	*
Temple Heights channel		*			*	
W side of Islesboro:		*			*	*
Turtle Head to Fort Pt Lt.		*			*	*
Fort Pt. L. to Dosen Shoal		*			*	*
W Big Cove, Holbrook I.		*				*
N Horse Cove to S Holbrook I		*				*
Head Cape Rosier to Horse Cve	*					*
Head Cape Rosier deep water		*			*	*
Western I. bell, bumpy ridges	*				*	
Barred I., just N & W		*			*	*
Channel by Hewes Pt & Resolution		*				
Channel by Hewes Pt & Green Ledge		*				*
Gravel Humps twrds W Egg Rk		*				*
Hog I. deep hole (old)		*			*	
Under Reach bridge (old)		*			*	*
W side N Haven to Turtle Head (old)		*				*
Edge of Scallop Shore		*				*
SW Islesboro		*				*
E Islesboro, ledges E of grn buoy		*				*

Western Penobscot Bay and Approaches

Rockland Bay, 80-90 fathoms						
Trial Course Buoy		*				*
Tow Outside Metinic		*				*
N of Monhegan I most anywhere		*			*	*
East of the Coo		*				*
Metinic		*				*
Haddock Hole by Haddock Rock		*				*

HADDOCK & COD SPAWNING GROUNDS (continued)

Key: Lg = large; Sm = small

GROUNDS	SEASON			SPECIES		
	Winter	Spring	Sum.	Fall	Cod	Haddock
Western Penobscot Bay and Approaches (continued)						
White Head Channel		*			* Lg	* Sm
Perrys Ldg (Garden Ground)	*	*				* Lg
Monroe I Tow (gravely)	*				*	
Junkens Ldge Hole	*	*				*
Fosters L		*			*	
Collins R		*			*	
Pigeon Ground Tow		*				*
South of Vinalhaven						
Tow Head	*	*			*	*
Bay Ledge	*	*				*
Saddleback Rf to Bay L	*	*			*	*
W of Bay Ldge	*	*			*	*
E of No Mans Land		*			*	*
N of Seal Island,	*	*			*	*
Jackup	*	*			*	
W Seal Island		*			*	*
Sunken Seal Island		*	*		*	*
Just N of Malcoms Ledge		*				*
W Malcoms 1, in 4Of		*				*
Gully between 3F&Seal I		*				*
E Wooden Ball I		*			*	
N Wooden Ball I deephole	*	*				*
N Wooden Ball I			*		*	
Frenchmans L		*	*		* Lg	
Eastern Penobscot Bay and Approaches						
Brown Cow to Eagle I(01d)	*	*			*	
Edge from Babbages I to Sheep		*			*	
Triangle L	*	*				*
Western Head to Bull L		*				*
Western Head to Saddleback	*	*				*
The Roaring Bull	*					*
Spring Ground		*			*	
Red Top Bank		*			*	*
The Gilky	*				*	*
Gravel Btm&SE Grnd	*				*	*
Jericho Bay and Approaches						
Fog I Deep to Mark I		*				*
N Spoon I to Mahoney I		*				*
NE side Spirit L.		*				*

HADDOCK & COD SPAWNING GROUNDS (continued)

Key: Lg = large; Sm = small

GROUNDS	SEASON			SPECIES		
	Winter	Spring	Sum.	Fall	Cod	Haddock
Drunkard L to Hat I Bar	*				*	
Drunkard L to Blue Hill Rk		*	*		*	*
Saddleback L, Jericho Bay			*			*
E Spoon I. to Drunkard L		*			*	*
Horse Reefs to E side Spoon		*			*	*
Off Spoon I		*			*	
SW end Old Maids Tow	*	*			*	
South of Isle au Haut	*	*			*	*
SE Isle au Haut			*		*	
Grumpy, N & SW side		*			*	*
65f hole SSE Grumpy		*				*
E 65f hole SSE Grumpy		*			*	
East Cove, Frenchboro		*				*
Outer SW Cove, Frenchboro		*				*
Channel S of the two coves		*			*	*
1.5 mi SW SW Pt, Long I		*			*	*
Hitchell (Stanley Bottom)			*		*	*
715 line S Lng I (45-50f)		*			*	

Blue Hill Bay and Frenchmans Bay to Petit Manan

Blue Hill Bay and Approaches

N Placentia I			*		*	*
Up to Hardwood I, Blue Hill Bay			*		*	*
W Placentia Head		*			*	*
Against E Big Shoal, 10 F Shoal			*			* Sm
Upper Green I Channel		*			*	*
Just over edge Grn I		*			*	
Edge E Psnch Shoal		*				*
Lower Green I Channel	*				*	*
N Long I		*			*	*
E Long I		*				* Sm
Grn I Chnl, off Bell		*				* Lg
20 f Edge E Drums L		*			*	
Abner Ground/S Drums Ldg		*				*
SW Grt Duck I->NW Ltle Duck		*			*	*
E side Great Duck I		*			*	*
E of NE end Gr Duck I		*			*	
1 Mile E Great Duck I		*				*
S side Grt Duck I		*				*
N Grt Duck I		*	*			*
45-50f Chnl SE Gr Duck I		*			*	
W Little Duck I->NW		*			*	

HADDOCK & COD SPAWNING GROUNDS (continued)

Key: Lg = large; Sm = small

GROUNDS	SEASON			SPECIES		
	Winter	Spring	Sum.	Fall	Cod	Haddock
Blue Hill Bay and Approaches (continued)						
Shoals between Grt Duck & MDRk		*			*	*
Mt Desert Rk		*			*	*
The Pratts, NE Peak		*			*	
Davis Shoal	*				*	
N SW Shoal/S LI (45-50f)		*				*
Frenchmans Bay and Approaches						
Somes Sound		*			*	*
E Bunkers Ldg towards BH Bay		*				* Sm
SW Hbr, out the Western Way		*			*	*
3 mi SE Bakers I, Tow NE		*			*	*
Tuckers Rock		*	*		*	
45-50 f Edge W Bluenose		*	*		*	*
the Hop to Ironbound I	*	*			*	
Petit Manan to Quoddy Narrows						
Simms Rk		*				*
Southeast Rk		*			*	
Tibbetts Rk		*			*	*
NE Jordans Delight		*				*
NW Nash I		*				*
Egg Rk		*			*	
Channel Rk to Seahorse Rk		*			*	
Libby I and Stone I Channel		*			*	*
Libby I & Cross I Channel		*				*
Double Headshot to Long Pt		*			*	
Flat outside Petit Manan	*	*				*
Moose Peak to outside Libby I		*			* Lg	
S Cross I		*			* Lg	
NW cove Libby I		*			* Sm	
Machias Bay (W Cross I)		*			*	
Grand Manan Channel, 1953	*	*				*
SE North Shoal		*				* Lg
Boot H to N Little R 35&48f		*				* Lg
Boot H SE-E to Can Line	*	*			*	
40f line N Cutler to R Buoy	*				*	* Lg
Betty Ground to off Egg Rk		*				*
Western Head to Cape Wash		*				*
East side Petit Manan		*				*
Eastern Intermediate Grounds						
South-southwest Ground	*	*			*	*

HADDOCK & COD SPAWNING GROUNDS (continued)

Key: Lg = large; Sm = small

GROUNDS	SEASON				SPECIES	
	Winter	Spring	Sum.	Fall	Cod	Haddock
11-Mile Ridge		*				*
Bowdies	*	*			*	
Haddock Nubble	*	*			*	*
Outer Falls	*	*			*	
Clay Bank	*	*			*	*
Skate Bank	*	*			*	*
Newfound	*	*			*	
Moosabec Ridges	*	*			*	
Inner Schoodic		*	*		*	*
Outer Schoodic		*			*	
Bank Comfort	*	*			*	