Changes in the Florida Keys Marine Ecosystem Based Upon Interviews With Experienced Residents

Karen DeMaria

April 1996

The Nature Conservancy
201 Front Street, Suite 222
Key West, FL 33040

Center for Marine Conservation

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1725 DeSales Street, NW
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PREFACE

"I remember when..."

Memory is a powerful motivation for those who care about the environmental health of places we love. Where environmental quality has declined, past conditions often become goals for the future. Returning the marine ecosystem of the Florida Keys to "the way it used to be" is a goal for many who are worried about its current state, and its future. But what was "the way it used to be"?

Answering this question is extraordinarily difficult. Describing something as complex and variable as the Florida Keys marine ecosystem, even with today's sophisticated scientific methods, is a challenge. Trying to reconstruct the past from the recollections of individuals is even more challenging. The memories of a Key West fisherman about conditions in the 40's will differ from those of a Key Largo diver recalling the 60's. Furthermore, just as no two witnesses at a crime scene ever report precisely the same events, no two observers of the Florida Keys of the past would be expected to recall exactly the same conditions. However, taken together, just as in a court case, the recollections of a number of witnesses can help reconstruct the past.

This report represents a collection of memories. It is important at the outset to make clear what it is not. It is not a rigorously reviewed and verified scientific report, with extensive compilation and comparisons to the scientific literature. Neither is it an "oral history" as defined by historians. It is a summary of the recollections of those who were "eyewitnesses" to environmental conditions in the Keys 30 or more years ago. No attempt has been made to determine which memories are "right" and which are "wrong."

What can we conclude from the report? The conclusions reached by the reader will, we expect, depend a great deal on the reader. Some readers will be able to test the recollections contained in this report against their own memories and their own points of view. Here are our impressions, *based solely on the reports described in the text.*

- Water quality has declined, including the water quality in canals, near-shore areas, Florida Bay, and the coral reefs.
- Algal blooms are larger, more frequent, and more persistent.
- Although seagrass beds have fluctuated in the past, both in extent and species composition, the condition of seagrass beds in Florida Bay has definitely changed for the worse.
- Corals and the coral reefs show signs of declining health: disease is more common, colors seem to have faded, and algae have increased.
- Populations of many invertebrates, including sponges, giant anemones, sea stars, calico and decorator crabs, long-spined sea urchins (*Diadema*) and queen conch have declined, although the latter two appear to be recovering. In contrast jellyfish, generally speaking, have increased.
- The harvests of stone crabs and lobster have been fairly constant, although fishing effort increased steadily until recently. Divers, however, report declines in the number

and size of lobster. Catch per unit effort of pink shrimp declined severely in the late eighties, but may be recovering.

- Sightings of whale sharks and manatees have increased; while sightings of hammerhead and blacktip sharks, sawfish, and bottlenose dolphins have declined. Sightings of sea turtles declined years ago, but are increasing now.

- Tropical fish generally, and specifically butterfly fish and angelfish (and perhaps seahorses and cowfish), have declined in abundance.

- Bait fish abundances vary geographically, with declines in Florida Bay and increases in the lower Keys and around Key West. Ballyhoo and mullet populations have declined.

- Groupers generally have declined, in particular gag, black, snowy and jewfish. Nassau grouper, on the other hand may be increasing. Jewfish seem to be recovering since the zero bag limit was established.

- Marlin and swordfish have declined, but are slowly coming back; sailfish also declined, but have increased with the modern emphasis on catch-and-release sport fishing.

- The abundances of tilefish, bluefish, grunts, snook, and tarpon do not appear to have changed. Bonefish may have declined.

- The abundances of dolphin (mahi-mahi), redfish, and spotted sea trout declined, although redfish are now apparently recovering.

To summarize, with relatively few exceptions, the changes described in the interviews are changes for the worse.

It is worth noting again that the above conclusions are based solely on the observations of those interviewed for the report. Obviously, their observations depend greatly on the time period and geographic area they were familiar with. With regard to some changes, the reader will encounter contradictory statements in the report. Similarly, opinions about the causes of changes vary greatly.

Despite all the uncertainty, however, the most basic conclusion is inescapable. The Florida Keys marine environment has changed from what it once was, and not for the better. It is our hope that this report will encourage more investigations into "the way things were" as well as inspire further efforts to protect what we have today and secure a promising future.

Many thanks to all those who participated in this effort.

Paul B. Dye, Director of
Marine Conservation
The Nature Conservancy
Florida Keys Initiative
Key West, Florida

Michael F. Hirshfield, Ph.D., Director
Ecosystem Protection Program
Center for Marine Conservation
Washington, DC

AUTHOR'S SUMMARY

It seems that each generation dreams of past days when fishing was better than today. It is clear that long-time residents and fishers in the Florida Keys agree that our marine resources have generally declined.

The goal of this project was to record comments on changes in the Florida Keys marine ecosystem over the last three or more decades by interviewing people who have spent most of their lives on these waters. The statements contained in this report reflect their views and ideas.

Fishing in the Keys varies with weather conditions, the migration of fish through the Keys and their seasonal abundances, regulations, and market forces. Consequently, only a few people confine their fishing activity to one kind of fishing. The fishers interviewed said it now takes longer and requires more effort to catch the same amount of fish and lobster than in the past. They use more gear and more efficient gear, and travel greater distances. The huge schools of fish once commonly seen in the Keys are no longer as large. According to those interviewed, fish have become "skittish" and the schools have been broken up.

Over the past 30 to 40 years water quality has declined in canals, nearshore waters, Florida Bay, and along the reef. Many fishers are concerned that water quality changes are triggering declines in habitat quality and fish stocks. Almost all of those interviewed said the water conditions of the canals have become worse because of development along the canals and more full-time use of homes on the canals.

Declining water quality and habitat losses in Florida Bay are apparently "driving fish out of the Bay." According to the interviews, fish are moving farther west and migrating around Key West rather than through Florida Bay. There has been an observed decline in the numbers of birds and baitfish in Florida Bay, and a corresponding "explosion" of birds and baitfish in the lower Keys and Key West. Interviewees from the middle and lower Keys also describe shifts of fish, lobster, and crab catches to the west.

Water quality has also declined at the coral reef. Divers report lower visibility and a lot of particulate matter in the water. From their perspective, 40 feet of visibility was considered bad in "the old days," now it is good. It was more common years ago to have visibility of 100 feet. There is more silt and algae on the reef, and the colors of living corals are not as vibrant. The reef lacks a pristine quality it had in the 1950s and 1960s.

Over the same time period, more people have moved to or visited the Keys. In the minds of many people who spend their lives on the water, there are too many boats, too many people fishing, and too many people using the Keys marine environment.

Karen K. DeMaria
Summerland Key, Florida

INTRODUCTION AND METHODS

This project was carried out to document eyewitness accounts that can contribute to identifying and solving environmental problems in the Florida Keys.

The goal of the project was to record comments on changes in the Florida Keys marine ecosystem over the last three or more decades. Information was gathered by interviewing people who have spent many years on the waters surrounding the Florida Keys.

The individuals interviewed had firsthand knowledge of changes in the marine ecosystem. They were divers, fishers (commercial and recreational), scientists, and long-time residents of the Keys. Every interviewee had at least ten years experience on Keys waters; most had more than twenty.

Interviewees were identified by placing ads in newspapers throughout the Keys, mailing letters to appropriate organizations (including the Sanctuary Advisory Council, city and county commissioners, civic clubs, chambers of commerce, the Conch Coalition, Monroe County chapters of Organized Fishermen of Florida, etc.), and making presentations at public meetings.

Interviews were conducted with one or two people at a time, at their choice of location. Some information was gathered over the phone and some was received through the mail. Between March and July 1993, information was collected from 75 individuals. Sixty-nine of these interviews were in person, three were phone interviews, and three individuals sent their information by mail. Most interviews were tape recorded. Each interview began with a brief explanation of the information being collected. Background information on each person (eg. age, education, and residence location) was gathered.

Each person was asked to provide information about changes in fisheries, seagrass communities, the coral reef, algal blooms, and water quality. Each was presented with a list of species and habitats (Appendix A) to prompt specific memories and provide a framework for the interview. Everyone was encouraged to include personal comments and stories. At the end of the interview, each person was asked to comment on the *most significant* change(s) that he or she had observed in the Florida Keys.

The short duration of the project limited the amount of information that could be collected. People were very generous with their time, but other people with valuable insights remain to be interviewed. Since this is the first report of its kind about the Keys, the information that people wanted to share varied a great deal, and it does not lend itself to statistical analysis.

What appears in this report is an overview of the comments received. The interview tapes, notes, and documents comprising the sources for this project contain more information than can possibly be covered here, but this report provides an objective representation of the material. Under each topical heading, relevant comments from the interviews are summarized and set in context with historical accounts and data from published sources. Direct quotes from the interviewees are used to illustrate prevailing and important dissenting opinions. Quotes are not attributed to individuals in this report, but they are direct transcriptions from the interviews.

This study confirmed the value of anecdotal reports from experienced Keys resi-

dents on the nature of changes in the local marine environment. Much of that value will only be captured if others conduct follow-up interviews with more specific objectives. The focus of the project was to capture people's *observations regarding change* more than to solicit *opinions on the reasons for change*, but both observations and opinions appear here.

PEOPLE INTERVIEWED

Capt. Jimmy Albright, retired fishing guide. Lives in Islamorada.

Warren Bailey, retired boat builder. Lives in Key Largo.

Capt. Art Barton, fishing guide. Lives in Key West.

Freeman Bateman, Sr., commercial shrimper. Lives in Marathon.

Ray Bentley, recreational fisher. Lives on Big Pine Key.

Fernand Braun, backcountry guide. Lives on Little Torch Key.

Arnold Bryce., Jr., commercial fisher. Lives in Key West.

Capt. Jack Burleson, retired dive boat captain. Lives in Marathon.

Dr. Charles Bush, retired veterinarian, recreational fisher. Lives on Big Pine Key.

Billy Causey, Superintendant, Florida Keys National Marine Sanctuary. Lives on Big Pine Key.

Laura Causey, former tropical fish collector. Lives on Big Pine Key.

Capt. Cal Cochran, flats fishing guide. Lives in Marathon.

Edwardo Cordova, commercial fisher. Lives in Marathon.

Tim Daniels, commercial fisher. Lives in Marathon.

Capt. Ed Davidson, charter boat captain. Lives in Marathon.

Billy Deans, Key West dive shop owner. Lives on Sugarloaf Key.

Don DeMaria, commercial fisher/diver. Lives on Summerland Key.

Glenn Evans, diver/boat captain. Lives in Key West.

Larry Foltz, commercial shrimper. Lives in Key West.

Bill Gibbs, marine research assistant at the Keys Marine Lab in Layton.

Peter Gladding, commercial fisher. Lives in Key West.

Jamie Green, commercial bait shrimper. Lives in Key Largo.

Blondel Handcock, commercial fisher. Lives in Key West.

Manny Handcock, commercial fisher. Lives in Key West.

Debbie Harrison, environmentalist, recreational fisher and diver. Former deck hand on a commercial lobster boat. Lives on Big Pine Key.

Larry Hendricks, owner of a marine products store on Stock Island. Born and raised in Key West.

Jack Hill, owner of a fish house and a former commercial fisher. Lives on Key Largo.

Bob Holston, dive shop owner. Lives in Key West.

Ted Hoversen, U.S. Customs agent and recreational fisher. Lives on Sugarloaf Key.

Anthony Iarocci, commercial fisher. Lives on Grassy Key.

People Interviewed

Capt. Vicki Impallomeni, wilderness guide and charter fishing captain. Lives in Key West.

George Jones, park manager and recreational fisher. Lived in Key Largo at the time of this report.

Netannis Kline, long-time resident and recreational fisher. Lives on Summerland Key and has been a resident of the Florida Keys for more than 25 years.

Norman Kline, long-time resident and recreational fisher. Lives on Summerland Key and has been a resident of the Florida Keys for more than 25 years.

John Koenig, banker, long-time resident and recreational fisher. Lives in Key West. Over 40 years of experience fishing in Florida Keys waters.

Curtis Kruer, consulting biologist and charter flats fisher. Lives on Big Pine Key.

Freddy LaLonde, commercial fisher. Lives in Key West.

Mike Laudicina, commercial fisher. Lives on Big Pine Key.

Debbie Layne, long-time resident and recreational fisher. Lives aboard a boat anchored off Big Pine Key.

Karl Lessard, commercial fisher. Lives in Marathon.

Ed Little, fishery reporting specialist for the National Marine Fisheries Service and recreational fisher. Lives in Key West.

Jerry Lounsbury, commercial fisher. Lives in Marathon.

Theron Lowe, retired Florida Keys commercial fisher. Lives in Dade City.

Herb Marvin, lawyer, part-time commercial mullet fisher. Lives in Miami and owns a home in Key Largo.

Capt. Charlie "Tuna" Mills, retired charter boat captain. Lives on Summerland Key.

Marshall Mills, commercial fisher. Primary residence is Marathon.

Ed Moore, commercial fisher. Lives in Marathon.

Robert Nathan, economist and recreational fisher. Lives primarily in Arlington, Virginia and has a winter home in Key West. Has been fishing in the Florida Keys since 1937.

Mark Nease, diver/boat captain. Lives in Key West.

Ken Nedimeyer, commercial fisher/diver. Lives in Tavernier.

Joyce Newman, environmentalist, and recreational fisher. Former public school teacher. Lives on Big Pine Key.

Gary Nichols, commercial fisher and seafood supplier. Lives on Lower Matecumbe Key.

Dave Nolan, director of a medical center. Former charter boat captain after retiring from the Navy. Lives in Key West.

Joan Nolan, part-time commercial fisher. Lives on Sugarloaf Key. More than 20 years experience as a recreational diver and fisher in the Florida Keys.

Bennett Orr, commercial fisher. Lives in Marathon.

Mandy Rodriquez, dolphin expert and recreational fisher. National Marine Fisheries Service contact for sea mammal stranding in the Florida Keys. Lives in Marathon.

Pete Rosin, commercial fisher/diver. Lives on Big Pine Key.

Dr. Jonathan Roth, college professor/scientist, Boshen College, Indiana. Has been bringing classes to the middle Keys each spring for 20 years.

Cecelia Roycraft, dive shop owner. Lives in Key West.

Bernard Russell, part-time private fishing guide. Born and raised in the Florida Keys. Lives in Islamorada.

Ernest Salazar, retired businessman and recreational fisher. Born and raised in Key West, then moved away as an adult. Now lives in Key West.

Simon Stafford, commercial fisher. Lives on Big Coppitt Key.

Mimi Stafford, commercial fisher and sponge wholesaler. Lives on Big Coppitt Key.

Merle Stanfill, commercial fisher. Lives on Big Coppitt Key.

Capt. Buck Starck, retired charter boat captain. Lives on Lower Matecumbe Key.

Terry Starck, beachcomber and environmental observer. Lives on a sailboat off Lower Matecumbe Key.

Grady Sullivan, commercial fisher/diver. Lives on Big Pine Key.

John Swanson, marine services supervisor at the Keys Marine Lab in Layton.

Ed Swift, Jr., businessman and recreational fisher. Grew up in Marathon, lives in Key West.

Dr. Jim Thomas, scientist (amphipod specialist) at Smithsonian Institution, Washington, D.C. Long-time resident of Ramrod Key.

Ray Van Houten, "jack of all trades" and recreational fisher. Lives aboard his boat off Big Pine Key.

Bill Wickers, charter boat captain. Lives in Key West.

Pete Worthington, commercial fisher. Lives in Marathon.

Dan Yieder, commercial fisher. Lives in Marathon.

Dr. Jay Zieman, scientist (seagrass expert) at University of Virginia. Has conducted seagrass studies in the Keys and Florida Bay for many years. Has a home on Big Pine Key.

People Interviewed

Figure 1. Age
Total number of interviewees: 75
Male: 66
Female: 9

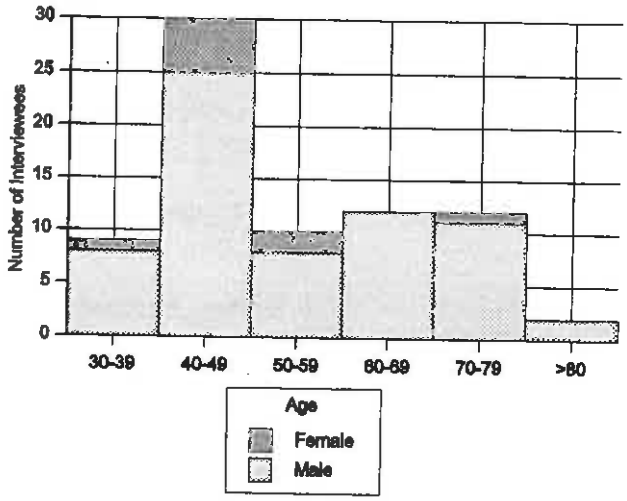

Figure 2. Years of Formal Education
Total number of interviewees: 75

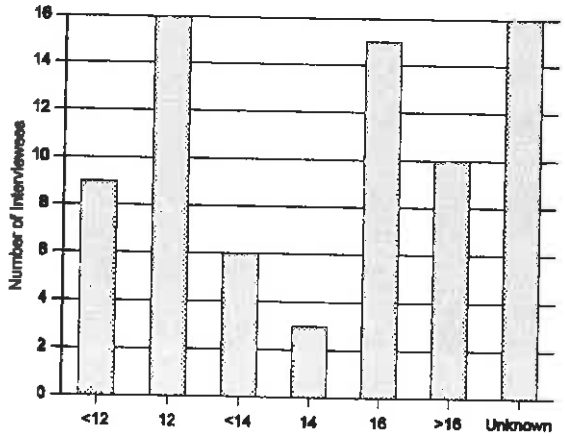

Figure 3a. Resident Status
Total Number of Interviewees: 75

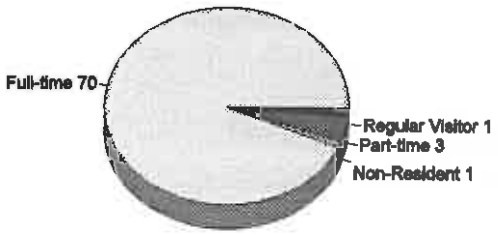

Figure 3b. Resident Location
Total Number of Interviewees: 75
Lower Keys: Big Coppitt Key to Bahia Honda Key
Middle Keys: Conch Key to Lower Matecumbe
Upper Keys: Upper Matecumbe Key to Ocean Reef Club

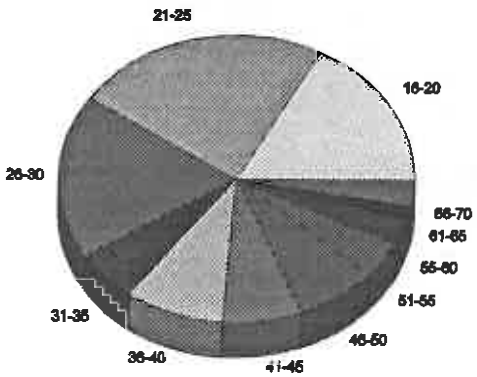

Figure 4a. Years of Experience
Total Number of Interviewees: 75

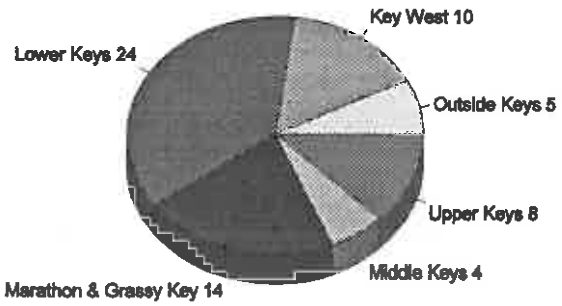

Figure 4b. Regional Experience
Multiple responses result in a total greater than 75.

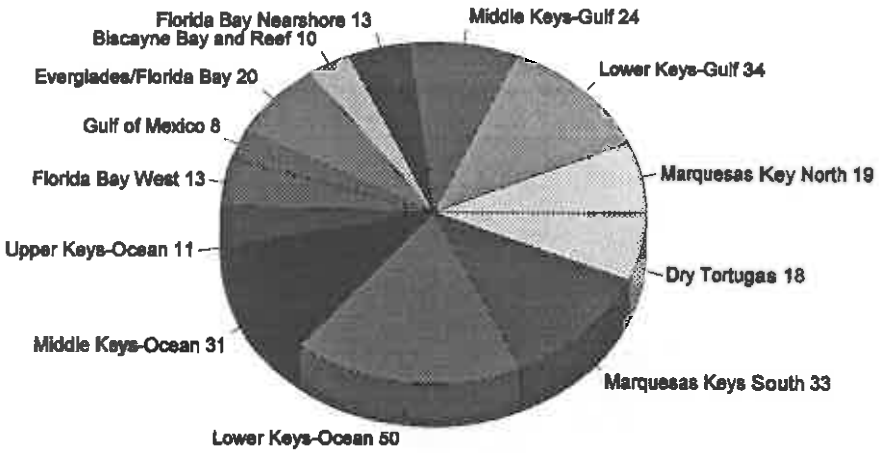

Figure 4c. Primary Experience Type
Multiple responses result in a total number greater than 75

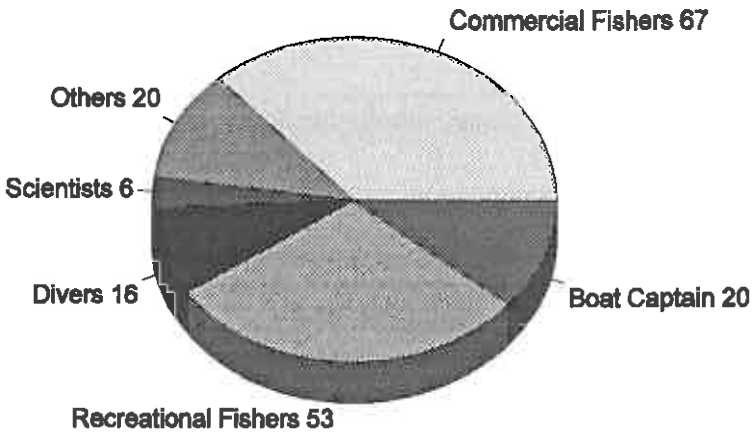

Table 1. Breakdown of Experience Types

Commercial Fishers	
Traps (lobster, crab, fish)	18
Handline and Hook and Line	15
Diver (lobster, spearfishing, tropicals)	15
Salvor (commercial or shipwreck)	2
Netter (all kinds including castnet)	9
Shrimper (food and bait shrimp)	6
Sponger	2
Boat Captains	
Reef and Deep Water Charters	8
Flats Fisher and Tarpon Guide	9
Wilderness Guide/Naturalist	3
Recreational Fishers	
Flats Fisher	13
Near Shore Fisher (including canals and bridges)	20
Reef	17
Deep Water	3
Divers	
Recreational	5
Dive shop owners, workers and captain or crew	6
Snorkler	5
Scientists	
Full time residents of the Keys	4
Part time residents of the Keys	1
Not a resident of the Keys	1
Others	
Government Employee (includes NOAA, Marine Patrol, Coast Guard, Customs, NMFS, Sanctuary, et al.)	7
Marina Owner or Employee	1
Boatbuilder and/or seller of boats	2
Spotter Pilot	1
Seafood Wholesaler or Fishhouse Owner	2
Marine Supply Store Owner	1
Marine Historian	1
Liveaboard	3
Environmental Observer	2

INFORMATION FROM THE INTERVIEWS
PART I: FISH AND OTHER VERTEBRATES

FISHERIES AND FISHING

This project included a search of historic and scientific documents to provide background information for comments from the interviewees. In the sections below, statements and statistics from these secondary sources are presented first to provide a context for the interview information, which then follows. The report summarizes prevailing opinions, illustrated by representative comments from the interviews, and also documents important contrary opinions.

In Daniel Beard's report on the Everglades National Park (1938), he says:

> "Workmen at Fort Jefferson have all been commercial fishermen. ...Every fisherman interviewed pined for the 'good old days' when you could really catch fish to make a living."

Willam Schroeder, a scientific assistant with United States Bureau of Fisheries in 1923, provides a good summary of the Monroe County fishing industry in his report, *Fisheries of Key West and the Clam Industry of Southern Florida.*

"The Bureau of Fisheries' statistical canvas of 1918 shows that 458 persons were engaged in the fisheries of Monroe County at that time, and nearly all of these were credited to Key West.

> "This number is considerably augmented in winter, however, during the height of the mackerel and king-fish season. ...The fishing fleet is composed mainly of small boats, some of which are equipped with sails only, some with gasoline engines, and some with a combination of the two. These boats seldom travel far from land and are used chiefly in fishing on nearby reefs.
>
> "The most important products of the Key West fisheries are reef fishes, Spanish mackerel, kingfish, mullet, sponges, turtles, spiny lobsters, and stone crabs. ...The small reef fishes ...are caught at all seasons of the year. They comprise, for the most part, grunts, snappers, yellowtail, porkfish, porgies, triggerfish, jacks, and small groupers. ...Fishing is done entirely by hook and line. ...a small minnow seine or cast net is used to secure fish bait.
>
> "The larger reef fishes consist mostly of groupers, jewfish, hogfish, large porgies, and large snappers. ...handlines only are used ...Other species, such as sharks, rays, morays, and salt water catfish, are taken but are not regarded as food fish."

Fishing Habits

Interviewees were asked if -- during the course of a year -- they fished in different areas, changed gear, or changed target species. They were also asked if they still fished in the same general area as they did in the past. And they were asked to explain the changes.

People change their fishing locations regularly. Generally, people in the Keys choose where to fish based on weather conditions. The direction and strength of the wind determine which area the fishers

use, whether oceanside, gulfside, reef, deep water, or nearshore waters. Flats fishing also depends on knowing the tides. Tides have become a major influence on other kinds of fishing more recently as water quality has declined. According to fishers, local water conditions deteriorate when "dirty" water from the Gulf and Florida Bay is drawn through Keys channels toward the ocean. Fishers avoid this water, and say the fish do, too.

Competition also affects where people fish.

> "I move around [in the Dry Tortugas area] due to competition. I would start fishing for grouper and snapper in one area and would get good catches, and then other people would move into the area. It does not take long for the word to get out. When I change location, I also change gear design and target species. I change every three years or so due to competition. It is the same ecological area but not the same specific area."

The kind of fishing people do is largely dependent on supply and demand.

> "In the 1940s and 1950s, I worked primarily as a net fisherman catching silver mullet, mackerel and pompano. The price of crawfish was so low that it wasn't worth fishing for them."
>
> "[There is a] demand for tropicals more in the fall and winter. I saw a decline in resources and changed target occupation to be more able to enjoy nature as an occupation longer."
>
> "[The type of fishing I do is] dependent on weather and demand. I spearfish more in the summer and collect tropicals more in the winter. In the summertime, I fish the Gulf wrecks for snapper, jewfish, and amberjack. I no longer go after jewfish due to protective laws. In the spring and early summer, fish mainly the Tortugas area for snapper and grouper because the water used to be clearer there. In the spring, I fish the reefline. Predominant fishing area was south of the Quicksands and Rebecca Channel [west of Marquesas]. In 1993, I stopped fishing Tortugas and the waters of the Gulf of Mexico fishery jurisdiction due to the abundance of fish traps in that area ...too much of a hassle. Weather, water clarity, supply and demand, and fish populations determine which area to fish and when. Now my catch includes more variety of fish than before, including jacks, triggers, margates, and porgies. Prices are higher now for the snapper and the grouper."
>
> "In a typical year, from August to December I crawfish, from October to May I stonecrab, from March to June I fish for cobia (hook and line and handline), from May to June I fish for dolphin, in June I fish for snapper, and in July and August I dive for tropicals. The change is due to seasonal closures; doing different things helps to break the monotony and I am fishing for items during their peak seasons in order to get the most monetary gain. Fishers of the middle Keys who fish in Florida Bay are having to move further west to catch crawfish and fish. They have to change due to problems with water clarity and loss of habitat. I keep moving gear around to where the fish are. The change in fishing in west Florida Bay seems to correlate with the shrimp decline and the seagrass die-off of the mid 1980s. Fish are either moving closer to the shoreline of the Keys, to the west, or deeper offshore. The fish are moving to where there is clean water.

Changes in fish distributions are primarily due to Bay water quality and change in food availability."

Abundance and Catch

Interviewees were asked if it takes more or less time to catch the same amount of fish now as they did in the past. Also, they were asked if they noticed differences in fish populations in certain areas.

Most people said it takes longer to catch the same amount of fish than in the past, and it requires more effort. "The fish have become skittish." In the past, there were plenty of fish available to catch and fewer people fishing. Interviewees offered various reasons for the declines in fish populations: the use of certain gear types, loss of habitat, declining water quality, and increasing numbers of fishers (both commercial and recreational).

"I am seeing yellowtail now in areas where they never used to be. Jewfish Bar [north of Marquesas] used to always have big fish, now only small fish. Fish in the old days were only caught if they could be sold. Little waste. They were kept alive until sold, then killed. See a lot of abuse with spearfishing and charter boats, wasted fish just for photos."

"The Salt Run area in Key West, ten years ago used to have a lot of life. Jewfish, snappers, snook, tarpon were prevalent and the bottom was a hard bottom community. Now, it has lots of horseshoe crabs and a four to five foot deep layer of silt on the bottom. I think it is primarily due to the increased development in the area and runoff."

"Since the late 1980s, I am having to go further away into the Gulf to get fish. Now there is a market for fish that there never used to be. It takes more time now with the same gear to catch the same amount of fish that I caught in the past."

"I saw a change in Spanish mackerel and pompano. There has not been a run of Spanish mackerel in Hawk Channel since 1966 due to change in water flow and tides in Florida Bay. Pompano and mackerel need clean water and shrimp to eat."

"The dirty water [algal blooms] in Florida Bay has had the strongest impact on snappers and groupers, sharks, baitfish, mackerel, and cobia. Overall, the most noticeable change is the lack of fish. The fish that are thriving in the Bay right now are the fish that like dirty water, including mullet, blue runner, catfish, ladyfish, and bonnethead sharks."

"Schooner Bank [near the Everglades National Park boundary in Florida Bay] had fish all over the place. Everywhere, all over the bank. Oxfoot Bank was the same way. In May 1949, while fishing at the northeast end of Buchanan Bank, I watched fish moving east to west all day, a lot of tarpon and mullet. Prior to the 1950s, commercial fishermen on Plantation Key would catch bonefish, trout, and stuff from Captain's Key to the north end. Never saw them around Arsnicker, Buchanan, or Ninemile Bank until after 1955, when they moved down that way. Around 1953/1954, I fished Coupon Bight. There used to be lots of tarpon in there, usually in late March/April. Beautiful area. Used to see large blacktip sharks near Green Mangrove and Arsnicker Keys."

"Pompano and mackerel used to go through the Long Key Bridge. About four years ago it changed and now

they stay offshore or go west. The migration occurred when the water got cooler. The big months used to be December and January. ...In the old days, we used to look for the school of fish in Florida Bay by looking for the baitfish and the birds, now we have neither. The traditional fishing areas and methods are gone in the Bay due to the algal bloom."

"Around the old bridges there used to be large schools of fish under the bridges [tarpon, lookdowns, spadefish, snapper, snook, and jewfish]. When the old bridges were removed and new ones built, the fish left and haven't come back -- at least not in the numbers they were before. The fish have moved out to other places. I think it takes awhile for a school to establish an area, a territory. ...The San Pedro wreck [off the middle Keys] used to have large schools of fish, including a big school of baby amberjack. When the wreck started to be 'worked,' the fish disappeared from the area and haven't come back. At the Islamorada Humps, the big Warsaw groupers have just about disappeared."

"In the early 1970s, there used to be a lot of big fish in the nearshore waters, in about 10-12 feet of water on the patch reefs. By the late 1970s/early 1980s, there were less fish, and now it is rare to see them in those areas. I think it is primarily due to more people impacting those areas."

"Still have some large predator fish within the boundary of Pennekamp. I have noticed an overall decline in the fish population. I think it is related to the fact that there appears to be less coral, therefore, less cover for the fish. I have observed an overall habitat decline. We always remember things being better than they actually were."

One commercial fisher said his catch from the Dry Tortugas has steadily increased, but the composition has changed.

"In Tortugas, fishing has steadily increased. I am having one of my best years right now [1992/1993]. In the past, out of a catch of 3000 pounds of fish, 200 pounds would be yellowtail and 200 pounds would be hog snapper; the rest would be grouper. Now, out of a 3000-pound catch, 1500 pounds will be yellowtail and 900 pounds would be hog snapper. The rest of the catch would be grouper. I am catching more snapper now."

Overcrowding

Interviewees complained most that there are too many people using the marine environment -- driving boats, living in the Keys, catching the fish, etc. As one person said, there is "too much fishing pressure."

To many, the increase in fishing coincides with advances in technology that have replaced human skill.

"A lot of the fishermen today do not have the experience or knowledge. They rely on electronics and gadgets."

"People and fishers have increased and technology has increased. No skill is needed now to fish. People need to learn how to operate boats."

"In the old days, skill and knowledge was needed. Modern technology has changed all of that."

"Increased development of the Keys has brought an increased population. All due to easier access, due to road

improvements, improved water lines, and improved and more reliable electricity. Can't control access. People are taking everything. There is a lot of waste. People are still poaching many conch and lobsters. See a lot of anchor damage from idiot boat drivers. Overall, there is a lack of courtesy on the water."

"There are a lot more people on the water that have no boater experience. I am also seeing a lot more recreational use of the nearshore waters by jet skiers and water skiers."

Many long-time residents were concerned about the type of people who fish in the Keys now.

"I have seen a problem with sportfish boats swamping others. Some people have no fishing etiquette or manners and it is increasing."

"In the old days fishermen used to help each other. Now they help very rarely. There is a different class of fisherman today. His character, attitude, and fellowship is different – for the worse. They are much more greedy now."

"Social changes have been big. In the old days, commercial fishers were respected, not now. A different kind of person is now moving into the Keys, while the old timers are moving out. Average boat size has also changed. It used to be normal to have a 14 to 18-foot-long boat. Now 24-foot is the standard. People are now very disrespectful and have very little regard for other people and their property. In the 1960s, there were not many people on the ocean. In the 1970s, there were not that many people in the backcountry. Now the people are everywhere; can't get away from them. People are now too greedy."

Fishing Gear

Interviewees were asked if they have changed their primary gear over the years. In the 1920s, the primary kinds of fishing gear in the Keys were handlines, wire crawfish traps, and nets. Hook- and- line and handline fishers used cotton twine for line. Several old handline fishers working out of Key West said they are still fishing with the same type of gear they used when they first started. Most have not changed types of gear, but each type of gear has evolved.

"Fish have become educated through the years. Used to use heavy green line; can't anymore because you wouldn't catch the fish. Too much modern stuff involved in fishing now, due to the increase in 'sporties' [recreational fishers]."

"I have always used hook-and-line. In the 1930s and 1940s, I used star drag reels, bamboo rods, and linen line. Now the rods and reels are very sophisticated and light (made of fiberglass) with monofilament line of varying thickness."

One interviewee gave the following historical account of sport fishing:

"In the late 1800s to 1900s, fishing was done by harpooning and handline. In the 1920s, more fishing poles were being used. From the 1900s to the 1930s, I had heard comments about the huge schools of bonefish and tarpon, hundreds of them in a group. ...With fishing lures, technique is very important. In the 1940s, only two people used live bait for fishing off Islamorada. Live bait was always better

than dead bait. With live bait, I could catch 8-10 sailfish a day while other guides would catch none on artificial lures. Ninety-nine percent of the fishing up until the 1940s was live bait. There were no artificial lures like we have today. In the 1940s, they started trolling spoons and feathers. Back in those days, there wasn't enough fishing for the fish to get smart to anything. It's not like today where the fish will turn away from lures or plugs. Can't use plugs anymore, fish won't take them. The hooks today are the same as in the past. ...In the old days, we would take a launch (large boat) and tow a few skiffs or row boats. One person's job was to be bait catcher (mullet or crab for tarpon, conch for bonefish). Bonefishing became popular because of the winter residents. Could catch bonefish right along the shoreline of Islamorada. Everyone basically fished for tarpon, bonefish and sailfish. In the 1930s and 1940s, kingfish were looked down on as a recreational catch. Back in the 1930s, there wasn't much fishing in the Bay. Started catching bonefish on fly in 1948/1949. In the 1960s, plastic models were used more for mounts. Prior to then, it was normal to kill fish for a trophy mount or a photo. Large fish and first time catches were always brought in for pictures and mounts."

One person said changing regulations and the potential for making more money led him to change his primary gear from hook-and-line and handline to fish traps and wooden crab traps.

Bycatch is a sensitive issue to many fishers; the term is even defined differently by various people. Interviewees were asked if their gear had a bycatch and if they have noticed a change in the composition of their catch. Several interviewees stated that there is no bycatch with hook-and-line gear, except that undersized or oversized fish are sometimes caught. A former longline fisher said his bycatch consisted of stingrays and nurse sharks when he was fishing for other sharks. Others stated that sailfish and marlin are often caught on longlines targeting swordfish.

One fish trapper said he does not have a bycatch, because everything he catches is used.

> "Everything caught in the trap is used. Ninety percent of my catch is target species."

Many people wanted to talk about wire fish traps. Wire crawfish traps were used in the Keys in the 1920s, but not in large numbers. Wire traps were also used then to catch angelfish, tangs, and crabs in nearshore waters. By 1953, State law allowed only wood for lobster traps, with the exception of one wire trap per boat. In 1980, it became unlawful for anyone to possess, use, or transport wire fish traps, or to market fish taken in wire fish traps in Florida fish houses. Effective January 1992, wire fish traps were banned by the South Atlantic Fishery Council.

Many said they believed that fish cannot learn to avoid wire traps. They also noted that grouper populations seem to rise and fall with the absence and presence of wire fish traps. Such comments came from throughout the Keys and from almost all user groups.

> "Since the fish traps have been banned, I am seeing more mutton snapper [off Marathon and the lower Keys]. The general trend in the population decline is due to fish traps. When fish traps are not around, the population seems stable."

"I once found a fish trap in six feet of water that had eight grey angels in it."

"In 1992, I started to see an increase in larger snapper and groupers on the reef off Big Pine. I feel that it is due to the recent fish trap law [the prohibition of wire fish traps in federal waters of the South Atlantic]. In 1978/1979, a change started to occur when fish traps became more popular."

"In the mid to late 1970s, when fish traps were first being used in the Keys, I saw a quick decline in the fish populations. In the early 1980s, the State of Florida prohibited fish traps and the transportation of the traps through State waters, and the fish made a brief comeback. When the State law was overturned, the fish went downhill. Since the fish trap ban in South Atlantic waters [January 1992], the grouper are starting to come back. More people are seeing and catching grouper now than in the past years. I see a direct correlation between the fish populations and fish traps."

"Groupers, especially blacks, and mutton snappers -- this year there are plenty being caught by everyone. This is due to the fish trap ban in the South Atlantic waters."

Weather

Most interviewees agreed that weather patterns had changed in the Keys, with definite effects on fishing and fish populations. Many said that we are having milder winters now and that water and air temperatures are warmer.

"We haven't had a good cold winter in over ten years. In the 1950s, we had real cold winters. It used to be that we would get northwest winds that lasted three to four days with a hard, continuous 20-25 mile per hour wind. Now it blows from the northwest one day, then switches around to the northeast."

"Change is related to fresh water and heat. Twenty years ago, I could predict the type of fishing season based on the weather. Now everything is different. Cold northerners that used to blow for weeks would clean out Florida Bay. We don't have that now. Twenty-three years or so ago, we had systems that came through with strong winds like the March 1993 storm. In the old days, by November 1, we would have already had 15 northerners."

"In the past, we used to start getting the northeasters in early September. During the months of October and November we would have steady northwesters. It used to be that it would get so cold that you could see catfish on the surface swimming in circles. The whole weather pattern has changed. Overall, we have a lack of real cold winters now."

"[In a] low pressure system, the fish move around a lot; [in a] high pressure system they don't."

In the "old days" in the Keys, according to some, when the wind stirred the water it became a cloudy, blue-white color that settled out fairly quickly. Now the water becomes a green-brown color when stirred by the wind; it takes awhile to settle out (if it does at all) between fronts. This, too, has an effect on fishing.

"Most fish are sight feeders. So when water clarity gets bad, they don't eat. When the water clarity is constantly bad, they leave the area."

Fish Kills

Fish kills have always occurred in the Keys. Most have been associated with cold fronts and dropping temperatures that stun fish in shallow waters. In the book *Charlotte's Story,* Charlotte Neidhauk wrote about life on Elliot Key in 1934 and 1935. She described a cold spell and its effects:

> "The temperatures dropped to the low 30s that night. ...[The next morning], I saw many fish laying along the shoreline, the shallows offshore...were thick with more! All sizes including sharks up to five feet in length. ...Did the cold kill them? Not actually, they are cold-blooded. When the temperature goes down it makes them sluggish and they lose their sense of balance, then they are at the mercy of the wind and the tide. ... There are a lot of saleable fish out there. ...gather them in burlap bags and tie them in the water at the dock. They will stay alive. ...found in the seaweed...this trumpet fish is only three inches long...tiny barracuda...some rare sea snakes ...a three inch sail fish, its sail spread...seeing a huge red snapper drifting toward shore...a baby swordfish. ...One item in the paper told of a ten-foot reef shark near the Bahia Honda Bridge."

According to interviewees, cold weather kills occurred in the winters of 1976 or 1977 off the lower Keys, in 1982 or 1983 in Key West harbor and shallow areas around Key West, and in 1979 in nearshore shallows of the lower Keys. Water temperatures as low as 41° Fahrenheit were recorded in 1979.

> "In January and February 1977, we had a cold winter. Ninety percent of the parrotfish died in the shallow water. A smaller, cold water fish kill occurred in 1985, which killed a lot of the parrotfish in the canals."

In addition to the cold weather kill, a few people said they had observed a hot water kill.

> "In June 1980, there was a massive fish die-off. We had four to six weeks of flat, calm, hot weather. The canal water temperatures got up to the mid-90s. Fish were on their sides acting like they had ick [a fish disease]. We brought them back to the house and put them into an aquarium set-up and they recovered. It took a couple of months for the water to recover. I think it was from oxygen deficiency."

Several people also said there have been recurring fish kills in Florida Bay associated with hot water in the summer.

Several people described fish kills they associated with algal blooms.

> "In July 1982, near Big Coppitt Key, there was a fish kill coming from the Atlantic side. I think it was a red tide."

> "Three years ago, there was a fish kill at Cotton Key, off Islamorada, due to an algae bloom."

Many commented on a fish kill they associated with the removal of the C-111 plug in 1988, which released a large amount of fresh water into Manatee Bay and Barnes Sound. This fish kill was observed in Barnes Sound, Blackwater Sound, the Adams Waterway, and Largo Sound.

One interviewee said when the canals at Cape Sable were plugged, there were big fish kills.

Other comments on fish kills were:

> "In 1979, there was a toxic spill of four barrels of [a chemical] on Pickles Reef off Islamorada. There was a big fish kill, and it took several years to recover."

> "August 1, 1987, I saw a shad die-off at Sandy Key, east of the mud."

> "In 1991/1992, I saw a lot of dead fish [bonefish, permits] floating in the backcountry..."

Other Concerns

Most of the interviewees offered comments about fishery management.

> "Florida is way behind the times [with fishery management]. The data and record keeping is screwed up. The regulators crunch numbers but do not take into account what is happening in the real world. [As an example] a regulation will cut a gear group out of fishing for a certain species, and the landings will go down. Instead of realizing that, the fishery people further regulate because they see it as a stock collapse, not a cause and effect from regulations. Give the size limits and bag limits a chance to work, give it time."

> "Too many loopholes in the laws. A lot of the regulations are not really working because they are not enforceable."

> "There is, and always has been, a black market down here in the Keys. The history of the Keys has always involved lawlessness. A lot of the fish that are caught are not reported. Can't rely on just stats when evaluating fish stocks; need to use common sense."

> "Existing fishery laws are not enforced. A lot of the charterboats and boat captains [who are not commercial fishermen] are selling their catches to fish houses. They are getting double incomes. The Courts cannot handle enforcement."

> "When I stand up and say something at the fishery council meetings, the managers say, 'Yeah, you're only here to protect your tail. You'll say anything.' ....The conduct of the councils needs to be changed. Now, while speaking, the council members doodle or talk to each other, basically ignoring your talk. To a less educated person, this is like being blown off. ...It's as if the councils are provoking you by treating you like a second-class citizen, just because we are commercial fishermen and do not have college degrees. Most of the people on the council do not care if they put someone out of business. Scientists and fishermen should and must work together."

Several people said that dark spots on the fins of reef fish have increased, particularly over the past five years. People have noted this in areas off Key West, Marathon (oceanside), and the middle Keys.

> "[Off the middle Keys] four to five years ago, I noticed tumors and abnormal growths on mangrove snappers. These tumors appear to be getting more numerous."

> "[In the lower Keys], I am seeing a lot more tumors on the gray snappers. In the 1970s, I never saw tumors on the grays, but now I have to be selective because a large portion of them have tumors."

> "Since the early 1980s, I have seen tumors on gray snappers in the backcountry of the lower Keys."

Two long-time residents told of "bombing" events in the Keys and the effects they had on fish populations.

> "In the 1950s, on the reef, an oil company was doing some echolocation bomb testing. I saw porgies, black angels, [and other reef fish] floating around, all dead."

> "An old fisherman told me about the Navy bombings and how the water was littered with tons of dead fish. In the late 1960s/early 1970s, the Navy was bombing in the deeper waters. This man stated that he was off American Shoals when, after a while, a huge amount of dead snowy grouper and tile fish were floating by him. He stated that the dead fish were directly associated with the Navy bombing."

> "In 1981 or so, the Navy was doing some testing in 600 feet of water off the lower Keys. I think the Navy was doing some 'shock testing.' I saw dead fish floating after those tests."

FISH SPECIES

During the interview, interviewees were asked to comment on any changes they had observed regarding the fish species listed in Appendix A.

The State of Florida, Department of Environmental Protection (formerly the Department of Natural Resources) issues a list of the top 20 species in production. This list represents the top marine species in production throughout the *entire* State of Florida, and is based on 1990 landing estimates. Table 2 is a listing of those species.

Landings and catch information has been included for some species in the section below for historical reference. Table 3 is a chart from the National Marine Fisheries Service (NMFS) representing 20 years (1971-1991) of landings data on the principal commercial species in Monroe County.

Significant changes in landings have variable explanations including changes in reporting requirements, quotas, gear changes, bag limits and size limits, weather conditions, closed areas, and market conditions.

Landing information from 1935 was found in Daniel Beard's document, *Wildlife Reconnaissance: Everglades National Park Project* (1938). This landing information targeted the species that are found in and around Florida Bay and reports fish that were landed throughout Monroe County. The report was prompted by a 1935 hurricane that passed over what is now Everglades National Park. Landings declined after the hurricane.

Landing information from 1918 was included in *Department of Commerce, Bureau of Fisheries Report of the United States Commissioner of Fisheries For Fiscal Year 1923.* However, the statistics are limited to fish landed in Key West.

Table 2. Florida's Top 20 Species in Production (1990 Landings)

RANK	SPECIES	TOTAL POUNDS (in millions)
1	Mullett	26.9
2	Shrimp	21.7
3	Blue Crab	14.2
4	Grouper	10.0
5	Shark	7.5
6	Stone Crab	6.2
7	Lobster	6.0
8	Snapper	5.5
9	Tuna	4.8
10	Spanish Makerel	4.4
11	Swordfish	3.6
12	King Mackerel	2.7
13	Amberjack	2.4
14	Oysters	2.2
15	Bluefish	1.5
16	Sea Trout	1.2
17	Dolphin	1.2
18	Tilefish	1.0
19	Pompano	0.963
20	Scallops	0.887

Table 3a. 1971-1980: MONROE COUNTY, FLORIDA COMMERCIAL LANDINGS IN POUNDS (WHOLE WEIGHT)
SOURCE: NATIONAL MARINE FISHERIES SERVICE

SPECIES	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Amberjack	3,700	4,700	8,300	12,889	7,422	3,200	2,579	8,640	25,111	15,467
Ballyhoo	83,000	86,200	89,800	212,163	165,576	138,600	174,659	311,724	139,402	199,958
Bluefish	50,600	38,600	82,700	33,565	29,672	71,400	397,909	145,052	137,541	191,066
Dolphin	37,800	54,600	69,200	68,536	104,494	82,900	60,296	89,977	62,376	82,763
Groupers & Scamp	502,800	513,400	495,700	667,716	728,106	1,343,000	818,402	1,019,809	821,576	509,794
Grunts	65,000	39,200	36,900	24,748	9,417	5,300	25,620	34,513	42,612	39,063
Hogfish	18,200	16,100	13,400	10,382	14,416	13,100	18,764	34,184	36,892	30,147
Jewfish	19,100	19,000	22,300	23,785	18,280	9,000	32,065	32,646	16,919	13,359
King Mackerel	635,900	187,800	1,440,500	2,400,546	685,932	1,593,500	4,885,467	1,328,240	1,489,530	1,652,037
Mullet, Black	2,900	0	0	0	41,891	5,300	23,737	32,828	23,836	35,286
Mullet, Silver	279,200	215,700	472,400	481,934	351,138	481,700	282,993	341,265	238,111	104,635
Pompano	95,700	88,800	91,900	75,645	110,941	146,700	221,841	146,782	82,036	78,270
Seatrout, Spotted	59,300	63,400	44,800	34,370	13,545	16,500	25,754	31,610	13,301	8,759
Snapper, Mangrove	288,000	337,600	293,000	295,921	167,769	178,900	227,932	240,117	252,525	279,048
Snapper, Mutton	181,800	139,100	159,900	192,885	178,804	129,600	124,839	160,469	162,305	140,427
Snapper, Red	27,500	21,700	28,000	25,723	31,918	48,300	32,556	15,532	9,659	29,632
Snapper, Yellowtail	836,100	741,000	726,700	798,565	591,731	810,500	653,651	735,104	656,784	535,531
Spanish Mackerel	2,962,600	1,751,500	3,554,500	5,223,441	3,267,101	6,356,500	1,735,056	1,022,508	1,277,512	1,054,365
Stone Crab	714,500	826,300	472,500	855,344	754,735	898,200	1,252,623	1,435,145	1,753,604	1,601,695
Spiny Lobster	4,653,200	4,814,000	5,247,400	6,606,127	4,980,292	4,274,900	4,713,538	4,656,018	6,793,105	5,606,031

SPECIES	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Shrimp, Total	11,296,700	10,101,700	12,145,000	11,230,548	9,671,099	10,045,700	12,456,141	11,823,110	12,110,199	10,162,392
TOTAL ALL PRODUCTS ABOVE + OTHERS	23,278,600	20,496,600	26,170,600	29,591,605	22,286,183	27,148,000	29,078,881	24,595,972	27,907,331	23,303,619

Table 3b. 1981-1991: MONROE COUNTY, FLORIDA COMMERCIAL LANDINGS IN POUNDS (WHOLE WEIGHT)
SOURCE: NATIONAL MARINE FISHERIES SERVICE

SPECIES	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Amberjack	14,816	93,487	68,184	103,294	88,107	199,671	460,451	622,444	719,239	949,900	1,056,974
Ballyhoo	201,046	136,953	291,287	301,359	268,914	291,665	188,666	485,998	494,967	415,680	695,755
Bluefish	201,883	285,380	252,814	258,834	231,284	124,529	89,645	230,225	102,690	31,905	77,619
Dolphin	65,786	148,290	182,151	268,033	173,418	342,226	270,947	268,913	569,504	451,924	856,742
Groupers & Scamp	885,255	1,010,626	853,002	1,099,094	738,856	779,498	811,605	709,988	587,893	422,978	392,629
Grunts	47,759	58,172	39,232	46,629	39,725	79,488	114,570	99,578	87,486	66,209	74,691
Hogfish	39,375	26,084	24,897	33,676	35,787	31,044	46,800	44,032	54,785	52,973	38,778
Jewfish	22,712	18,651	19,440	12,306	19,180	22,978	26,246	24,329	24,748	1,313	0
King Mackerel	2,946,348	1,836,766	1,282,236	1,030,361	710,128	1,601,479	472,090	533,605	216,114	859,054	254,643
Mullet, Black	53,975	27,792	17,597	3,867	21,660	13,779	19,338	19,538	47,756	14,887	25,318
Mullet, Silver	11,757	134,089	111,954	133,385	195,468	85,172	122,098	142,285	175,313	186,401	124,834
Pompano	93,499	76,976	59,406	195,118	100,170	187,402	125,246	124,344	108,077	111,341	35,806
Seatrout, Spotted	14,331	18,628	50,946	74,398	38,401	30,617	23,333	20,498	41,452	21,065	9,968
Snapper, Mangrove	278,784	470,259	532,944	598,060	483,366	479,635	535,309	358,141	387,370	257,642	269,942
Snapper, Mutton	145,447	259,288	183,282	151,099	147,539	176,492	273,132	184,516	274,337	226,041	260,055
Snapper, Red	20,682	16,515	7,876	8,728	4,459	4,340	4,266	3,771	1,692	2,894	5,401
Snapper, Yellowtail	639,863	1,257,985	846,222	861,773	762,048	991,101	1,234,050	1,259,673	1,637,938	1,577,100	1,648,397
Spanish Mackerel	2,213,197	2,283,511	1,316,558	3,098,851	2,136,879	1,832,351	1,822,228	1,010,532	2,284,893	1,151,016	1,335,935
Stone Crab	1,652,661	2,077,544	1,446,414	1,696,658	1,737,868	1,544,826	1,656,880	2,067,992	2,111,420	2,686,916	2,232,616
Spiny Lobster	4,952,091	5,538,172	3,571,393	6,011,531	5,421,524	4,332,028	5,467,353	5,768,592	6,905,769	5,400,548	5,909,880

SPECIES	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Shrimp, Total	15,733,173	7,660,142	7,812,094	10,730,878	10,544,220	6,927,755	7,364,560	4,401,624	3,850,950	3,991,388	3,267,315
TOTAL ALL PRODUCTS ABOVE + OTHERS	31,379,822	24,829,852	20,355,628	27,942,934	24,977,169	21,383,480	15,018,369	15,021,475	18,344,918	16,301,203	16,920,448

Sharks

Shark Landings		
NMFS Landing Data, high year	1989	389,847 Lbs
NMFS Landing Data, low year	1991	199,971 Lbs
Beard Everglades Document	1935	3,000,000 Lbs
Dept of Commerce Report	1918	Information not Available

Shark fishing provided important money for Key Westers during the Depression.

> "A seven-foot shark was valued at $1.50. Sharks were processed on Wisteria Island [Christmas Tree Island, off Key West]. Shark oil was processed from the livers, fins were dried and sold to Chinese merchants, and skins were sold to Ocean Leather Company."

Most people said shark populations have declined through the years. Some noticed a significant decline in the mid 1980s. Sharks were once a nuisance to fishers and spearfishers, but not now. Apparently, there were areas throughout the Keys where one *always* saw sharks, but in many of these same places, shark sightings are rare today.

> "There are not as many large sharks around anymore. They have pretty much disappeared. They used to be common."

> "It used to be common to see 12-foot-long sharks around the channels."

> "In the 1920s and 1930s, I used to harpoon the sharks to get rid of them, because they would become a nuisance. At the start of World War II, there was a shark factory at Tollgate [Lower Matecumbe Key] where they processed the livers, fins, and hides. The place only lasted about three years and then it closed due to lack of product. It is easy to locally fish down sharks."

> "Every spring, the sharks used to come into the flats just off [the south side of] the peninsula of Summerland Key, in the 1960s and 1970s, to mate or spawn. As more development occurred and the water changed, they stopped showing up. They haven't been around for many years."

> "There are not as many sharks around now, compared to the early 1970s. Sharks help clean up the carcasses of dead sea mammals that strand themselves. While doing necropsies, I used to have to fend off the sharks and work quickly to get the needed information. Now, they're not a problem."

Some comments indicated certain shark populations may be stable or increasing. Bonnethead sharks seem to have increased in the lower Keys backcountry. Several people also said they often see big lemon sharks on the flats.

HAMMERHEAD *(Sphyrna spp.)* AND BLACKTIP *(Carcharhinus limbatus)* SHARKS

Several people felt that hammerhead and black tip sharks are the most stressed shark species. They have decreased in numbers from both ocean and Gulf/backcountry waters.

Hammerheads were once common in the channels of the Keys, where they presented problems for tarpon fishers. One person claimed to have caught a hammerhead 20 feet long at the Channel 2 Bridge in the 1950s.

> "In May or so, the hammerheads came into the channels, especially Bahia Honda, following the tarpon. In the 1920s to the 1940s, after awhile I would have to stop fishing, because there would be so many large sharks around your little boat. You wouldn't be able to catch the tarpon."

WHALE SHARK *(Rhincodon typus)*

The whale shark is found in warm surface waters and feeds mainly on plankton. Sightings of whale sharks have increased the last ten years. Whale sharks have been sighted off Key West, off the Long Key and Seven-mile Bridge areas, and off the middle Keys.

SAWFISH *(Pristis sp.)*

Sawfish were once numerous in Florida Bay and throughout the Keys, close to the shoreline. Several historical books on fishing in the Florida Keys (c. 1920s) have photos of very large sawfish hanging on racks.

Everyone interviewed agreed there has been a significant decline in the numbers of sawfish in the Keys.

> "I haven't seen [a sawfish] in years. In the old days, some were harpooned but the biggest decline was due to the nets. [Sawfish] have a slow reproductive ability, and take a long time to grow."

> "I am seeing more sawfish around in the shallow waters, averaging in size from six to eight feet long. Some are 14 feet long. Still, there is not as many as in the old days, but they are coming back."

> "There used to be thousands of them in the Bay, around two to three feet long."

Tarpon *(Megalops atlanticus)*

In 1918, 500 pounds of tarpon were reported as landed in Key West. In the early days of sportfishing in the Florida Keys (beginning in the 1920s), tarpon was the fish of choice. Several people said tarpon are moving across Florida Bay more quickly now than in the past.

Another interviewee provided the following information:

> "In the old days [1950s], at the east end of Ninemile Bank while poling to the west, I used to see 2000 to 3000 fish in a large school. They also seem to school up more in the deeper channels like Bahia Honda. In the past, the school really didn't get bothered until they hit Miami. Now, the huge schools get broken up by the large number of boats here in the Keys. ...I used to be able to watch that event [spawning] happen. Now the fish are too skittish, because there are too many boats. The Channel 2 and Channel 5 bridges were one of the hot spots for tarpon in the 1930s and 1940s."

BONEFISH *(Albula vulpes)*

Bonefish is exclusively a sport fish today, but according to one interviewee, "native conchs ate bonefish."

Some of those who commented on bonefish said they have declined in recent years, but most felt they have simply changed their habits. Many people made comments similar to the following:

> "In the past, if you went to Shell Key anytime, any day of the week, you

would see 300 to 400 fish. There always used to be a lot of fish at the Swash [in Florida Bay], a thousand or so. Rabbit Bank was always a great place to catch bonefish between the channels. There were schools and schools of bonefish there. It was not unusual to see a thousand fish a day in the middle of Nine-mile Bank."

"Bonefish used to feed in shallow water; now they don't due to boat traffic disturbance. The fish probably feeds more at night now, because fishing for bonefish at night is better now than in the past."

Ballyhoo *(Hemiramphus spp.)*

Ballyhoo Landings		
NMFS landing data, high year	1991	695,755 Lbs
NMFS landing data, low year	1971	83,000 pounds
Beard Everglades Document	1935	information not available
Dept. of Commerce Report	1918	information not available

Ballyhoo is used primarily for bait, particularly by recreational fishers. Many interviewees had observed declines in the size of ballyhoo schools, especially in particular areas familiar to them. Some blamed net fishing and others blamed the numbers of recreational fishers who catch their own bait.

Mullet *(Mugil spp.)*

Mullet Landings		
NMFS landing data, high year for black mullet	1981	53,975 Lbs
NMFS landing data, low year for black mullet	1971	2,800 Lbs *
NMFS landing data, high year for silver mullet	1974	481,934 Lbs
NMFS landing data, low year for silver mullet	1981	11,757 Lbs
Beard Everglades Document	1935	229,000 Lbs **
Dept. of Commerce Report	1918	112,313 Lbs ***

*In 1972, 1973, and 1974, landings for black mullet in Monroe County were listed at zero

**Landing information is for all species of mullet. More than half the mullet was taken from the Everglades Park area

***Landing information is for all species of mullet. The salted roe of the mullet was also sold

Several species of mullet are caught in the Florida Keys. The black, or striped, mullet (*M. cephalus*) is valued commercially as a food fish. Silver, or white mullet (*M. cerema*) is primarily a bait fish, but it does have some local value as food fish.

Mullet was once protected during its spawning season by Florida regulations (Department of Commerce, 1923). Catching of striped (black) mullet within State waters from November 20 to January 20 was prohibited. Eventually, the roe became more valuable than the fish, and spawning seasons were reopened.

Several people said mullet were once abundant from Everglades City, southward to Cape Sable, and into Florida Bay. One person said silver and black mullet were once the most important fisheries for Key Largo.

"Mullet season used to be closed in December and January, State-wide

[roe season]. I fished for black mullet off Cape Sable from April to Thanksgiving. April is when the fish got fat again. The mullet fishermen would then migrate to Jewfish Creek/Lake Surprise and fish for silver mullet which roe in April. Black mullet was used for food while silver mullet was used for bait. ...We used to have big runs of silver mullet through Jewfish Creek."

Several people noted both changes in mullet populations and their disappearance from traditional fishing areas.

"The biggest change from 1940 to now is the mullet. There used to be miles of mullet mud, as white as walls in a house. We used live mullet for bait offshore, and we used to be able to catch mullet in the nearshore waters of the Bay [Little Matecumbe Basin]. I observed a change in the mullet in the early 1960s in the Everglades Park, due to commercial mullet fishing boats near Sandy Key Basin [south of Cape Sable]. A lot of the traditional mullet grounds are gone now."

"I used to fish for silver mullet in the spring. Most of it was shipped to New York. I used to catch them in Bamboo Bight [between there and the Quay in Marathon]. Right along the shore I could get a good strike -- two to three thousand pounds in the morning -- then go back to the same area in the late afternoon and do the same thing. I was able to catch mullet there all season in the early 1950s or so. That changed when more people started developing and moving to the shoreline. More lights and more boat traffic caused the fish to move away."

"In 1955 in [northeast] Florida Bay, the mullet disappeared during the summer and were gone all year. In 1957/1958, I saw silver mullet ...going toward the southwest in small pods. They left the area for three weeks."

"There was a collapse of the silver mullet population in the early 1970s. They haven't come back like it used to be. In the past, there used to be a lot more mullet mud area....The gear that the mullet fishermen used and their technique became too efficient. It took only a short period of time to wipe them out, and they haven't come back like they used to be....When there used to be algae blooms in the Bay, we were still able to catch mullet in the blooms."

"Silver mullet was dominant off Islamorada. In September, we would have runs of black mullet in the Bay, acres of them. I don't see the ocean runs anymore."

One person said he noticed a problem with mullet caught in Florida Bay.

"From 1980 to 1985, I caught numerous mullet in Florida Bay with cataracts on their eyes and large 'cancerous' growths."

Other Bait Fish

Until the 1950s, few bait stores in the Keys sold live bait. Most guides and fishers caught their own live bait. Now certain commercial fishers concentrate on catching bait fish for others, and stores throughout the Keys sell live bait.

Several people commented on declines in bait shrimp and bait fish populations. Most of these comments came from people familiar with Florida Bay. They believed the decline in water quality in the Bay caused a decline in bait fish and, subsequently, a decline in bird populations. In contrast, most interviewees from the lower

Keys and Key West said they are seeing an explosion of bait fish and bird life.

> "There are less bait fish in west Florida Bay. They have been displaced and are now gone from Florida Bay. The fish that used to be in Florida Bay have moved offshore and west. Huge schools of bait fish are offshore now, in 30 feet of water."

> "There has been a pinfish population explosion in recent years in the lower Keys."

Barracuda *(Sphyraena barracuda)*

Although barracuda have never been an important food fish in the Keys, 3000 pounds of barracuda were landed in Key West in 1918. Most barracuda have been caught for sport or to eliminate a perceived nuisance.

Barracuda are still common, but most people felt that barracuda populations have declined and that there are fewer large fish around.

> "There used to be a lot more barracuda on the flats in the past. They have gotten smaller in the flats area."

> "The biggest change in fishing is how, in the past, barracuda were a nuisance. Now, the large ones are not as abundant."

> "They are abundant on the flats, but not abundant on the reef due to indiscriminate killing for trophies."

Snook *(Centropomus undecimalis)*

In 1935, 1500 pounds of snook were landed in Monroe County. The Department of Commerce (1923), however, reports that snook were rarely taken in the immediate vicinity of Key West in the 1920s.

Snook became a game fish in the 1950s. In 1985, the State prohibited the sale of snook.

One interviewee said he caught ten snook at the north end of the Seven-mile Bridge in 1935. Other comments came chiefly from Islamorada and included the following:

> "In the 1940s to the 1960s, we never did much snook fishing. Snook was a popular food fish for the natives and was also commonly called a soapfish, because the skin tasted soapy. It is now considered one of the best eating fish. Snook became overfished almost to the point of being endangered. Also, mullet nets had a huge impact on the snook. Snook would eat the residue of the mullet mud. In the early 1950s, there was a discussion about whether to make snook a gamefish. Most people in the Islamorada area did not care one way or the other [at that time]."

> "In the 1950s, they took snook away from the commercial fishers. I have observed the snook slowly decrease. I think it is associated with pollution."

> "In the 1970s, the population collapsed. In 1988, they started to come back real strong. Now the population is better than ever. Now you even see the snook in the shallow waters."

Groupers

Grouper Landings		
NMFS landing data, high year	1976	1,343,000 Lbs.*
NMFS landing data, low year	1991	392,629 Lbs *
Beard Everglades Document	1935	32,000 Lbs
Dept. of Commerce Report	1918	200,000 Lbs
* All groupers and scamp, not including jewfish.		

Grouper landing data were not split by species until 1985. As one person explained:

> ". . .because in the early 1970s, all species of groupers were sold as 'groupers.' Then they were split to red or black groupers. The data base is distorted, especially when some people are still calling gags 'black' groupers and Nassaus 'red' groupers. Gags and yellowfin groupers were sold as blacks. Nassau groupers were sold as reds. Also, scamp and yellowmouth groupers are very similar."

it is still common practice for recreational fishers who fish in the Gulf of Mexico to call a gag grouper a black grouper.

When asked to name the dominant grouper species in the Keys, most replied that red and black groupers were the most common, along with jewfish.

> "The primary groupers in the Keys were red, black, and gag groupers."

> "The dominant groupers off Islamorada, in the old days at least [from the 1920s to the 1960s], were the black and scamp groupers."

"The dominant groupers off Key Largo are, and were, black and scamp groupers."

According to the Department of Commerce report (1923), the black grouper was common around the Florida Keys and Key West in the 1920s. The red grouper was the most common off Key West.

Nearly everyone said they have noted decreases in the size and number of groupers. Many blamed fish traps.

> "I have seen the biggest and fastest declines in the grouper population, in the size and numbers of them. I feel it is due to fish traps."

> "The Cosgrove/Tortugas area used to have a lot of grouper, then they disappeared for a long time. Recently they are reappearing. The trend follows the use and ban of fish traps."

> "In the late 1970s, I observed a decline in the groupers. It coincided with the increased use of fish traps in the Keys. The resurgence and decline of grouper coincides with fish trap regulations. Fish traps are wasting a lot of the adults."

One person said that, while he has seen a decrease in the size of groupers, the overall population seems fine.

> "[I have seen] some decrease in the size of the fish, but not in the overall population at Tortugas."

Black Grouper *(Mycteroperca bonaci)*

According to a 1923 Department of Commerce report:

> "Black grouper is taken throughout the year [1920], but it is most common during February, March, and April."

Black grouper have become much less common according to most people interviewed.

> "With the decline in black grouper, I saw a corresponding increase in yellowtail."
>
> "I used to guarantee money back to divers and snorkelers if they did not see 15 or so black grouper at Looe Key."
>
> "[Black grouper] are not in the shallow water as much as they used to be. I find them now in deeper water than in the past."
>
> "Black grouper is the number one grouper, and the best paying, because there is more yield."

RED GROUPER *(Epinephelus morio)*

Several interviewees said that the new size limits on red grouper seemed to be helping the population. One person remarked that he has not seen red grouper in Florida Bay. "They moved out," he said, and stated the opinion that water quality was the cause.

GAG (GRAY) GROUPER *(Mycteroperca microlepis)*

According to the Department of Commerce (1923), gag grouper were common near Key West in the 1920s.

> "Gag groupers may be caught near Key West throughout the year. Fish weighing more than ten pounds are rare."

Several people commented on the history of gag grouper populations in the Keys.

> "Off Islamorada, I would find them more in the Bay, all sizes."
>
> "Every fall, from 1955 to 1960, there used to be a migration of large gag groupers. They would come from the Bay into the shoreline of Lower Matecumbe Key. Residents got wise to it and started fishing it heavily. Because of that, and the filling in of the adjacent land for development (which caused a loss of habitat), the gags stopped coming."
>
> "Six to seven years ago, I used to see little gag groupers in Jewfish Basin [north of Boca Chica Key]. Not anymore."
>
> "In the mid 1970s, there was a decrease in population of gag groupers. It plummeted. Now I think they are coming back. I see a lot of little ones inshore."

Two people supported proposals to close the gag grouper fishing during spawning season.

SNOWY GROUPER *(Epinephelus niveatus)*

Snowy grouper are found in deep water. It appears, from comments collected, that there has never been a large population of snowy grouper in the Keys. Many claimed they had limited periods of good catches. It seemed to them that snowy grouper were easily "fished out" of a specific area or that they moved in response to fishing pressure. One interviewee claimed there were once "giant schools of snowy grouper in the Keys."

> "Fifteen years ago [1978], I used to fish for snowy groupers using deep-drop, 'Mickey Mouse rigs' in 800-900 feet of water, 17 to 20 miles offshore [off Marathon]. ...We ran the snowys out due to our ignorance. Fishing pressure on one area caused the fish to move away. Fish will come back to an area if they have habitat and food. Showys

will come back if their area is totally closed to everyone."

"In the early 1980s, off the south coast of Key West is where the snowy fishery started out of Key West. Snowys like deep, rocky drop-offs and humps--they are territorial. You catch them in water around 800 feet deep. During the summer months I would commercial fish for snowy grouper. Many thousands of pounds of grouper and golden tile were caught and sold then. There were no quotas, size limits, rules, or regulations on them."

"Snowy groupers used to be fished heavily in the late 1970s, then it died down. It was common then to see a boat unload 3000 pounds of snowy a trip. ...Snowys are found up to North Carolina, and I have heard that the farther south you go, the bigger the fish. It might be that we have the breeding stock here in the Keys!"

NASSAU GROUPER *(Epinephelus striatus)*

According to the Department of Commerce (1923), in the 1920s, the Nassau grouper was "one of the large and important food fishes of Key West." It was taken with hook and line throughout the year, with market fish ranging from 3-35 pounds.

People gave mixed comments about the population of Nassau grouper in the Keys. A majority stated that there has never been a large population of Nassau grouper in the Keys. Other fishers working off Key West and toward the Dry Tortugas had observed Nassau grouper more often.

"They never really were that numerous on the reef side of the Keys. You find them in large numbers in the Bahamas and Mexico."

"In the early to mid 1970s, I used to see a lot of Nassau groupers off Key West. By 1980/81, they had disappeared."

"Nassau groupers like live reef areas. We have never, and will never, have a population of Nassau groupers like the Bahamas, but we do have a healthy population in the lower Keys."

"Never had a big population of Nassau grouper in the Keys. The ones caught off Marathon were small. The bigger Nassaus were found in Tortugas."

"As a child [from the 1920s to the 1940s], I remember that there used to be lots of them off Islamorada. Three years ago I did not see any. Now they are coming back."

"We never had many Nassau grouper in the upper and middle Keys."

Several people did not believe the Nassau grouper stock in the Keys had declined, because there never had been a large population. They said many of the Nassau grouper landed in Monroe County were actually fish caught in Bahamian waters, especially Cay Sal Bank. It was also common for fish caught off Cay Sal Bank to be sold in Monroe County as fish caught in the Tortugas.

"A lot of the Nassau landings came from Cay Sal Bank. We never really had a big population of them off Marathon."

"There is not a major population of [Nassau grouper] in the Keys. Large populations of Nassau grouper exist on Cay Sal Bank and in the Bahamas. High landings in the past reflect those actually caught at Cay Sal and brought back to the Keys for sale. Cay Sal fishing ended around 1977/1980

due to enforcement. Even back to the early 1940s, we never really had a big population of Nassaus here in the Keys."

Many commented that, whatever the historic population, the Nassau grouper are increasing due to protective regulations.

JEWFISH *(Epinephelus itajara)*

Jewfish Landings		
NMFS landing data, high year	1978	32,646 Lbs
NMFS landing data, low year	1976	9,000 Lbs
Beard Everglades Document	1935	2,000 Lbs
Dept of Commerce Report	1918	15,000 Lbs

The jewfish is the largest of the groupers that inhabit the waters of the Florida Keys. It can grow up to 800 pounds. The fishery councils passed the first in a series of emergency laws in October 1990 to protect declining stocks. Jewfish are now completely protected from harvest under both State and federal laws.

According to the Department of Commerce (1923), jewfish was a food fish valued locally in the 1920s.

> "This fish is not plentiful in the Key West region [nearshore]. Spawning occurs during July and August, when the fish become gregarious and are caught in the greatest numbers. During six weeks of July and August, 1918, there were brought to market 74 jewfish, ranging in weight from 35 to 350 pounds. Nearly all of these were taken off Knight Key, about 40 miles above Key West. ...the entire catch being consumed locally."

The population of jewfish was once very large in the Florida Keys. Their numbers dwindled until regulations were passed prohibiting their harvest.

> "Jewfish used to be in the hundreds in the Everglades. They were everywhere, from small ones to 600-pound fish. The decline in their population started in the 1950s."

> "They like clean water and are sight feeders. I used to find juveniles in the mangroves in Florida Bay. I used to see 200 to 300-pound fish in five feet of water in the Park near the mangroves. I have seen 500 to 600-pound jewfish in eight to nine feet of water in the Bay."

> "In the late 1950s, we fished using an 'eye glass' made of cardboard with glass. In 50-60 feet of water during the jewfish spawn at Jewfish Bar [Maryland Shoals], we would select the fish we wanted to catch by putting the hook down in front of the chosen one, usually a 150-pounder."

> "Twenty-five to 30 years ago, I used to be able to catch large grouper, including jewfish and blacks in Northwest Channel by the jetty."

> "I used to see large jewfish in the mangroves in the backcountry [of the lower Keys]."

> "I saw a slow, gradual decline [in the jewfish population]. It became noticeable around 1988/89. In the early 1980s, you could still see large, 400 to 600-pound jewfish around."

Most interviewees said they noticed an increase in jewfish since protective regulations went into effect.

"I am seeing more jewfish now hanging out in the deeper wrecks in 100 to 150 feet of water."

"I am seeing more of them coming back now, but it is still not like it was years ago when jewfish were one of the dominant fish around."

"There used to be a lot of jewfish around, everywhere. They are coming back, but the numbers still are not there like they used to be. It was fairly common to see monster jewfish and even to see 200-pound jewfish in the shallow areas of Everglades National Park."

Many interesting comments were collected regarding jewfish. It seemed as though every interviewee had a jewfish story to tell, but this was among the best:

"In 1936, we went to the north end of Duval Street (Key West) at around noon and unloaded the fishing gear (handlines, hooks, and lead sinkers). The bait was shrimp caught off the salt pond bridge at Flagler Avenue. We would occasionally use lobster for bait, but it was more trouble to catch, cut, and bait the hook with the meat. ...Fish were plentiful in the waters surrounding the island then, and Dad threw the end of his line into the channel [Key West Harbor]. He had no trouble catching grunts and snappers right away. After about half an hour, the fish stopped biting. We suspected a large fish was in the area scattering the smaller fish. Dad immediately took a live fish and hooked it to his heavy 'jewfish line' and threw it out. He coiled most of the line on the seawall and tied the end of the line to the bumper of our old Chevy. When the coiled line started to feed out, Dad knew not to pull it in too quickly, lest he pull the bait out of the fish's mouth. He waited a few moments, then gave the line a big yank. The fish responded with a pull of his own and caught Dad off balance. He lost his grip on the line and watched the rest of the line uncoil from the seawall. I still say today that it was the Chevy that caught that fish because the line stopped when it stretched out from the bumper. Dad grabbed the line and pulled it in with all of his might. Others standing around offered to help pull the line in. As the fish was pulled in, everyone realized that it was a record size jewfish. It took several men with a gaff to lift all 375 pounds up onto the seawall."

Tilefish *(Lopholatilus chamaeleonticeps)*

In the Keys, tilefish are caught in deep water in the same habitat as snowy grouper. Fishers recognize two varities of tilefish in the Keys. The most common is the gray tilefish, but occasionally a golden tile is caught.

More tilefish have been caught in the past ten years than ever before. Tilefish has only recently become a target species, and the number of boats fishing deep waters has increased. Historically, very few people fished the deep waters around the Keys because nearshore fish populations were large.

Bluefish *(Pomatomus saltatrix)*

Bluefish Landings		
NMFS landing data, high year	1977	397,909 Lbs
NMFS landing data, low year	1975	29,672 Lbs
Beard Everglades Document	1935	3,800 Lbs
Dept of Commerce Report	1918	16,614 Lbs

According to the Department of Commerce (1923), bluefish were taken along the Florida Keys only during the winter in the 1920s.

> "...generally between December 15 and February 15. ...the greater part of the catch is taken along with the Spanish mackerel in gill nets or purse seines. ...The entire catch is shipped to New York."

Bluefish is caught by fishers from Marathon and the middle Keys, primarily in Bay waters. Most fishers from Key West do not catch bluefish.

> "They are not common down here. In 56 years of fishing in the Keys, I have only ever caught two or three off Key West and the ocean side of Marathon."

> "There used to be lots of big ones in the Bay and in the area off Long Key."

> "In 1992/1993, we did not have the bluefish in the Bay as in previous years. I used to see huge schools, 40-50,000 pounds in a school in the Bay."

Cobia *(Rachycentron canadum)*

Cobia is common in Gulf waters near the Keys, but it only recently became a target species for recreational and commercial fishers.

One person said he has seen a decline in the size of the fish. Another noticed a population decline of the fish in the Gulf.

> "Cobia have been drastically affected by the lack of clean water the last three years. They are a migratory predator fish. On my artificial trap reef pile in the Bay, it was fairly constant for me to have 60-70 fish at slack tide. For the past three years, I have only seen ten fish."

Jacks and Pompanos

AFRICAN POMPANO *(Alectis ciliaris)*

African pompano, an ocean fish, is caught in the Keys, though far less often than Florida pompano. Two people commented on the fish.

> "I catch them on wrecks in the deep water [170 feet]. It is an ocean fish."

> "It used to be fairly common, not unusual, to catch them. Now, it is uncommon to catch them. I think it is directly related to the lack of Sargassum."

CREVALLE JACK *(Caranx hippos)*

A few comments were made regarding crevalle jack in Florida Bay.

> "Near Sandy Key [south of Cape Sable], I used to catch lots of them, but they were small."

> "There used to be huge schools of them from East Cape to Northwest Cape in 30 feet of water. I thought it could be related to a spawn."

BLUE RUNNER *(Caranx crysos)*

Blue runner is not a commercially important fish in the Florida Keys. Historical information indicates that in 1935 there was a small local market for the fish. According to Beard (1938), 3600 pounds of blue runner were caught in 1935 in Monroe County with 1/3 to 1/2 of the catch coming from the Everglades Park area.

Several people believed the blue runner population has been increasing, perhaps because the species is more tolerant of poor water quality.

> "It likes the dirty water. Presently, they are taking over the Bay [west of the Park line]."

One person said there has always been a healthy population of blue runner in Florida Bay.

AMBERJACK (GREATER AMBERJACK) *(Seriola dumerili)*

Amberjack Landings		
NMFS landing data, high year	1991	1,056,974 Lbs.*
NMFS landing data, low year	1977	2,579 Lbs.*
Dept. of Commerce Report	1918	2,000 Lbs
*A significant increase in landings occurred in 1982		

One person said he always catches a lot of amberjack, all between 50 and 60 pounds. Several interviewees noted that Gulf of Mexico waters usually have amberjack "available for the catch." One person said, however, that large numbers of amberjack are only caught oceanside off the upper and middle Keys in the spring.

> "Amberjack are caught in April and May in the upper and middle Keys. That is the only time when there are any real numbers of them around."

Another person blamed deteriorating water quality conditions in Florida Bay for forcing amberjack to move further west into deeper waters.

> "In 35 to 55 feet of water, out from Cape Sable in the Bay, I used to see large schools of amberjacks. Now I only see them occasionally."

POMPANO (FLORIDA POMPANO) *(Trachinotus carolinus)*

Landing information on "pompano" means Florida pompano. Occasionally, African pompano are sold and recorded as pompano, but there is not a large harvest of African pompano in the Florida Keys.

Pompano Landings		
NMFS landing data, high year	1977	221,841 Lbs.
NMFS landing data, low year	1991	35,806 Lbs
Beard Everglades Document	1935	1,200 Lbs.
Dept. of Commerce Report	1918	545 Lbs

Pompano are found in schools and are most often fished in Florida Bay and surrounding waters.

Comments regarding pompano focused on problems in Florida Bay. Two people

attributed the decline in pompano landings for 1991 to algal blooms in Florida Bay.

> "There is a direct correlation between water quality and pompano populations. Pompano numbers have changed the last seven to eight years."

> "This year [1992/1993] there were none in Florida Bay. It is probably due to the algae blooms in Florida Bay."

Several people believed the abundance of pompano is directly related to weather and water quality.

> "The colder the winter, the more pompano in Florida Bay. They need clean water and shrimp to eat."

> "Pompano like colored water but not clear or murky water."

Some interviewees gave historical information about the population and harvest of pompano.

> "Florida pompano have always been sporadic. You could starve for three years then have a banner year of fishing. Old timers have told me that's how it's always been."

> "I used to catch a lot of pompano in Matecumbe Bight [Lower Matecumbe Key]. I could catch 100-200 pounds in one night. As more people developed the shoreline, and outboard motor use increased, it chased the fish away. Pompano spook easily. I also used to catch them near Long Key bridge and the Channel 5 bridge."

Dolphin (Mahi-mahi)

(Coryphaena hippurus)

Dolphin Landings		
NMFS landing data, high year	1991	856,742 Lbs.
NMFS landing data, low year	1971	37,808 Lbs.
Beard Everglades Document	1935	Information not available
Dept. of Commerce Report	1918	Information not available

Almost all of the interviewees said the availability of dolphin has declined in the Keys, due primarily to the decrease in Sargassum that forms floating weed lines attractive to the fish.

> "We are not catching the dolphin now, primarily because we do not have the weed line like we had years ago."

> "The dolphin population has gone to hell [commercially]. Not as many large Sargassum weed areas. You have to work hard to get the catches."

> "Four years ago [1989], in 21 days you could catch 17,000 pounds. Last year [1992], in over 21 days fishing I caught less than 5000 pounds of fish. In the past, the catch used to be constant."

While the comments indicate declining dolphin populations, landing numbers from the National Marine Fisheries Service have increased. A commonly offered explanation was that dolphin have become an increasingly important target fish for both sport and commercial fishers over the past decade.

Interviewees also believed there have been changes in where and when dolphin are caught.

> "In the 1960s, there were large schools of dolphin and they used to be closer in. There is not as much sargassum now. I have to go farther out to catch them."

> "It seems as though there are more dolphin available for capture in the winter time now than in previous years."

> "I have seen a decline the last three years. Usually, the water is a deep, sparkled blue in the stream, not lately though. In the past, we always had constant amounts of dolphin. There seems to be just as much debris as before, but the water seems warmer and dirtier. In 1992, we did not have the prevailing southeast winds that help to push the dolphin inshore. The weed line does not seem to have as much life under it, like it used to."

Snappers

MUTTON SNAPPER (MUTTONFISH) *(Lutjanus analis)*

Mutton Snapper Landings		
NMFS landing data, high year	1989	274,337 Lbs.
NMFS landing data, low year	1977	124,839 Lbs.
Beard Everglades Document	1935	19,200 Lbs
Dept. of Commerce Report	1918	25,000 Lbs

According to the Department of Commerce (1923) muttonfish was:

> "... one of the most important species of snappers caught about Key West, ranking close to the yellowtail. It is found throughout the year, but is scarcest during July and August, which is the spawning period and at which time it schools."

During the 1920s, most of the snapper fishing was done within a few miles of the shoreline, especially near Key West.

Many interviewees felt there has been a decline in the mutton snapper population. Most attributed this to traditional spawning aggregations being overfished and a decline in water quality in nursery areas.

> "There used to be a lot of small muttons in Florida Bay in the old days. Not anymore. The adult muttons found on the reef seem to be okay and are about the same size as in the past."

One person said there have never been many mutton snapper off Key Largo. Another person said the population has declined off Big Pine Key.

> "[There has been a decline] in population. The muttons are not that common off Big Pine Key anymore."

RED SNAPPER *(Lutjanus campechanus)*

Red Snapper Landings		
NMFS landing data, high year	1976	48,300 Lbs
NMFS landing data, low year	1989	1,693 Lbs.
Beard Everglades Document	1935	4,000 Lbs.
Dept. of Commerce Report	1918	9,000 Lbs.

According to the Department of Commerce (1923), in the 1920s:

> "[Red snapper] is one of the most abundant and valuable fish caught within the State of Florida, but near Key West it is comparatively scarce."

The comment from the Department of Commerce report confirms the comments from the interviewees:

> "[Red snapper are] seldom caught. Since the 1930s, we never had many off Key West."

> "Never really numerous off Key Largo and Marathon. [Red snapper is] mainly a Gulf fish."

> "From 1978 to 1985, while owning a fish house [in Marathon], I only shipped two American reds [red snappers] out of the Keys."

One interviewee said he once found a large number of red snapper.

> "We never really had a lot of red snapper here in the Keys. There was a site that might be a spawning site area where I once caught between 1000-2000 pounds of reds in eight to ten days of fishing. All of the fish were between 15 and 35 pounds. It's near Cosgrove Shoals [south of the Marquesas]."

MANGROVE SNAPPER (GRAY SNAPPER) *(Lutjanus griseus)*

Mangrove Snapper Landings		
NMFS landing data, high year	1984	598,060 Lbs
NMFS landing data, low year	1975	167,769 Lbs
Beard Everglades Document	1935	1,600 Lbs *
Dept. of Commerce Report	1918	15,000 Lbs.
*1/3 to 1/2 of the catch was believed to have come from the Everglades Park area		

According to the Department of Commerce (1923), mangrove snapper were the most abundant species of snapper found near Key West in the 1920s. The report says, "The best snapper fishing was found to occur when the weather was cloudy and the water not very clear."

According to Rutherford, et al. (1987), catch rates in Florida Bay and adjacent waters have fluctuated greatly since 1958 with peaks in 1959, 1964-1966, and 1977-1979.

The report gives some perspective on the mangrove snapper fishery and who was catching fish. It states:

> "Catches of gray snapper, an important recreational gamefish species in south Florida, have been monitored nearly continuously since 1958 in Everglades National Park... Most of the total annual harvest from 1973 to 1985 was taken by sport fishermen (78 percent) and guided parties (21 percent) with the remaining one percent taken by commercial hook and line and net fishermen.... The great increase in harvest in the mid-1970s was due to a great increase in guide harvest. The decline in effort, harvest, and harvest rates for gray snapper since 1979 is believed due to increased effort for other species such as spotted seatrout, as well as reduced stock abundance and recruitment."

A few people said they do not see the big schools of mangrove snapper in the ca-

nals or at the patch reefs anymore. One person attributed the decline to poor water quality in nearshore waters and Florida Bay. Most interviewees, however, believed the State ban on stab nets (February 1990) has resulted in an increase in mangrove snapper populations.

> "[The mangrove snapper are] coming back in the shallow waters since nets were banned."

YELLOWTAIL SNAPPER
(Ocyurus chrysurus)

Yellowtail Landings		
NMFS landing data, high year	1991	1,648,397 Lbs
NMFS landing data, low year	1980	535,531 Lbs
Beard Everglades Document	1935	52,700 Lbs
Dept. of Commerce Report	1918	50,000 Lbs.

Yellowtail has always been a target species in the Keys. In fact, several older Key West hand line fishers said that, while fishing for yellowtail, any grouper caught were thrown away.

> "In the 1920s and 1930s, I used to handline fish off Key West with some of the commercial guys. They would use cans of sardines as chum and for bait. The water around the boat would turn yellow with yellowtail. We would easily catch a lot of fish and keep them in the live well."

Interviewees felt that the population of yellowtail "looks fine." Some said the size of the yellowtail has changed.

> "In the past four years, the population looks good. The fish are smaller, but there are lots of legals. Not as many flag [big] yellowtails, though."

> "Yellowtail used to be larger, now smaller in size. I seem be seeing them more in the nearshore waters, the patch reefs, than in the past."

Two people disagreed with the comment that there are not as many big yellowtails.

> "Yellowtail have increased and they are bigger. I used to get flags over five pounds only in Tortugas and on the offshore humps. Now I get the flags on the reefs up and down the Keys."

All fishers have their own chum recipes and their own methods of chumming for yellowtail. Several people commented that more chum is used now, and that the chum formulas have changed. On the other hand, one commercial handline fisher said he has not changed his chum or method of chumming in the 60 years he has been fishing.

Grunts, all species

Grunt Landings		
NMFS landing data, high year	1987	114,570 Lbs.
NMFS landing data, low year	1976	5,300 Lbs.
Beard Everglades Document	1935	700 Lbs.
Dept. of Commerce Report	1918	150,000 Lbs.

According to some interviewees, "grits and grunts" were a mainstay for many Key Westers during the Depression. Some noted a decline in the size of grunts, but felt the population was stable.

> "I used to be able to catch one-foot-long grunts in Hawk Channel in the old days (1970s), but not in recent years. The size of the grunts has gotten smaller."
>
> "There are fewer French grunts in the upper Keys. There are a lot of blue and white grunts on the artificial reefs. I am seeing more tomtates [a type of grunt] now, which are common on the reef tract off Big Pine Key. I usually find tomtates in the Gulf in temperate waters."

Many people expressed disagreement with a proposal before the South Atlantic Fishery Management Council to establish a 12-inch size limit on grunts.

Spotted Sea Trout
(Cynoscion nebulosus)

Sea Trout Landings		
NMFS landing data, high year	1984	74,398 Lbs.
NMFS landing data, low year	1980	8,759 Lbs
Beard Everglades Document	1935	3,500 Lbs
Dept of Commerce Report	1918	Information not available

Sea trout is caught both by recreational and commercial fishers in the backcountry and bay areas east of Snipe Key (north of the Saddlebunch Keys). Several interviewees agreed there has been a decline in the sea trout population. Some blamed it on commercial net fishing; others blamed it on the growing numbers of recreational fishers.

Redfish (Red Drum)
(Sciaenops ocellatus)

Redfish has been a protected species in the State of Florida since January 1989. Because of the protected status, the sale of redfish is not allowed. The only historical landings information was found in Beard's Everglades Document (1938). In 1935, 3300 pounds of redfish were landed in Monroe County, with 1/3 to 1/2 of the catch believed caught within Everglades Park area.

Redfish is a temperate species of fish found in great numbers in bays to the north. Here, redfish is found only in the bays of the middle and upper Keys. The fish is caught primarily by recreational fishers in Florida Bay. Several of the experienced fishers in the lower Keys and Key West said they have never seen or caught a redfish.

> "They used to be considered a junk fish. Bay water used to be thick with them. They would scare the bonefish. Netting on the west coast of Florida wiped them out. [Redfish] making a strong comeback now, one of the reasons being the restocking of Biscayne Bay that is being done by University of Miami."
>
> "Fishing for redfish used to be looked down on in the 1930s and 1940s. Back in the old days, you could catch all the 25 to 30-pound redfish you wanted. They were plentiful."

Tropical Fish

Comments from throughout the Keys indicate there has been a decline in the numbers of tropical fish.

> "In the old days [1930s to 1950s], I used to see tropicals everywhere -- under any rock, near every bridge."

People gave various reasons for the decline. These included overcollecting, bycatch in fish traps and other commercial gear, and declines in water quality in Florida Bay and nearshore waters.

> "Lately, in the inshore waters, I am getting more tropical fish in my gear. I think it's because they are being chased out of the Bay area due to the bad water. I release the tropical fish..."

> "There has been an increase in the numbers of people in the tropical fish business in the last four years. ...Regulators must include the variables of each species [in setting limits] including season, site, depth, etc. ...A lot of fish are on cycles and the population is dependent on conditions at the time that age group spawns."

Several interviewees had observed fewer large parrotfish on the reef and in nearshore waters, especially near the middle Keys. A few, however, said they have seen increases in the schools of large parrotfish off Key West this year.

One interviewee said he has observed an increase in damsel fish (all species). He believed damsels prefer an algal turf community, and are taking advantage of increased algal cover in reef areas.

SEAHORSES *(Hippocampus spp.)*

One person related a story told to him by a bait fisher working nights in Florida Bay near Long Key. It was once common for bait fishers to catch 1000 seahorses a night. Now, they only average 100. Another person said she once caught seahorses in the canals on the northeast side of Big Pine Key, but not now.

BUTTERFLY FISH *(Chaetodon spp.)*

There are several species of butterfly fish in the Keys, the most common being the four-eye butterfly. They are usually seen in pairs. Several people commented on the populations of butterflyfish; all agreed they have declined.

Regarding spotfin and banded butterflyfish, one person said:

> "In the early 1970s, I used to see the large breeding pairs all over the place, then they disappeared because of fish traps. In 1992/1993, I am now seeing the breeding pairs again."

A comment regarding longnose butterflyfish attributed population changes to poor water quality and changes in water temperatures.

> "In 1983/1984, they [longnose butterfly fish] became displaced. They moved to deeper water because they are sensitive to water changes."

ANGELFISH
(Holacanthus spp. and *Pomacanthus spp.)*

In 1918, 5000 pounds of angelfish were landed in Key West.

According to a Department of Commerce Report (1923), angelfish were abundant around Key West in the 1920s.

> "[They] are found throughout the year. ...are taken in wire crawfish traps and with hook and line. It is a food fish of some importance locally."

Based on the interviews, angelfish populations declined in the 1980s and have been fluctuating ever since. Some claimed the declines were due to fish traps and too

much collecting; some said recent spawns had been poor.

> "Juvenile angelfish populations declined at the bridges in the early 1980s. In the mid-1980s, [the angelfish] started bouncing back a bit. There was a peak five years ago (c. 1988). I used to see dozens in areas where you now see one. ...I am seeing more butterfly fish and angelfish with parasites on their fins, especially on the west end of Looe Key."

> "The number of angels around is very dependent on the spawn and the conditions during the spawn. Populations vary -- good years, bad years -- it's always been like that."

> "1992/1993 was a good year for angelfish. Lots of blues, a few black, not many French. ...1987 to 1989 was a bad set of years for angels. 1985/1986 was a red hot year."

Although populations may have declined, several people said they have seen pairs of large angelfish within the last year, something they have not seen in a while.

HOG SNAPPERS (HOGFISH) (*Lachnolaimus maximus*)

Hog Snapper Landings		
NMFS landing data, high year	1989	54,785 Lbs
NMFS landing data, low year	1974	10,382 Lbs *
Dept of Commerce Report	1918	10,000 Lbs
*A significant increase in landings of hog snapper began in 1978		

Throughout the Keys, interviewees agreed that hog snapper have decreased in size. Two people attributed the change to the decline in sea urchin populations (*Diadema*). According to them, sea urchins are a favorite food of hog snappers.

> "[Hog snappers are] smaller in size now. I don't see that many large ones around anymore. [They] used to eat a lot of urchins, which were a big part of their diet. The change in size is probably affected by lack of their primary food source."

> "I do not see as many big hog snappers. Most fish houses have a self imposed size limit of 12 inches. Overall, I am getting more poundage than before, and the market is better now."

One person said that he was seeing smaller hog snappers in the middle Keys for a while, but that recently he has begun to see larger ones again.

Several people said the decline in the size of hog snapper is related to the increase in fishing pressure. The hog snapper is easily caught by hook and line, spearfishing, and traps. One interviewee also said he has noticed hog snappers spawning at a smaller size.

> "Hog snapper seem smaller and are now spawning at between eight to ten inches in size [off the middle Keys]."

Others observed that there are still large hog snappers in Dry Tortugas National Park and at John Pennekamp Coral Reef State Park, both of which have restrictions on fishing.

COWFISH (*Lactophrys spp.*)

Some interesting comments were received regarding cowfish, including several recipes for cooking them. Historically, cowfish were abundant in shallow, nearshore

waters, and Indians and (human) Conchs ate them. In fact, in 1918, 1000 pounds of cowfish were landed and sold in Key West.

It appears, from conversations for this report, that the cowfish have decreased, although some interviewees said they are seeing more cowfish now than in recent years.

Mackerels and Tuna

KINGFISH (KING MACKEREL)
(Scomberomorus cavalla)

Kingfish Landings		
NMFS landing data, high year	1977	4,885,467 Lbs
NMFS landing data, low year	1972	187,800 Lbs
Beard Everglades Document	1935	229,300 Lbs
Dept. of Commerce Report	1918	373,500 Lbs

According to the Department of Commerce (1923), kingfish were most commonly caught in south Florida from early November until late March in 1920. Kingfish were caught solely with hook and line. The entire catch for Monroe County was landed in Key West, and the fish usually ranged in weight from four to forty pounds.

Historically, kingfish were plentiful off Key West:

> "At the Quicksands [west of Marquesas] and American Shoals is where kingfishing was done in the 1800s and early 1900s. Kingfish Shoals [near Key West Harbor] also was a historical kingfish area."

> "There used to be such large schools of kingfish off Key West, you could basically walk on them. Four or five people could easily catch 2000 pounds of fish in three hours, with each fish weighing between 15-25 pounds."

Several people also commented on fishing gear and the weather:

> "Kingfish is a cold weather fish. There used to be large schools at Eastern Dry Rocks [south of Key West]. ...There has been a change in the fish pattern. They used to be in one large, enormous school. Now, they are all over the place in small pods. ...One year, I didn't catch kingfish, because the weather and water were too warm. 1978 was the coldest winter in the U.S., and we had great kingfish catches."

> "There used to be loads of kingfish years ago. Porpoises would eat them off the hook. Netters had pilots go and find the king schools and the nets would catch them all."

> "One year, in the 1960s, for three months there was a huge school of kingfish in Hawks Channel off Islamorada. Then the net boats came and wiped out the entire school. Never had them in such a large school since offshore here."

Kingfish regulations began in the fall of 1984, when gill nets were banned in State waters and a two fish bag limit was established. Prior to 1984, kingfish were netted in some State waters, at Sand Key and Crawfish Key. Federal regulations on kingfish have frequently changed.

Several people believed kingfish are coming back due to fishery regulations.

> "In the late 1970s, early 1980s, there were very little restrictions on kingfish. They were netted out in the early to mid 1980s. Since regulations have

been placed, the fish are coming back."

"Kingfish fishing was great in 1980/-1981. In 1983/1984, there was a tremendous decline. In 1988, the kingfish started bouncing back."

One commercial fisher argued that the regulations had caused economic hardship.

"I catch kings in the wintertime, in the Gulf, in 60-80 feet of water. The biggest impact was the regulations. When the State closed commercial fishing for kingfish in State waters, I went from 25 boats to ten boats."

SPANISH MACKEREL
(Scomberomorus maculatus)

Mackerel Landings		
NMFS landing data, high year	1976	6,356,500
NMFS landing data, low year	1988	1,101,532 Lbs
Beard Everglades Document	1935	841,000 Lbs
Dept. of Commerce Report	1918	1,734,200 Lbs

According to the Department of Commerce Report (1923), in the 1920s mackerel were commonly caught in south Florida from early November to late March. Mackerel were seldom seen 50 years before then.

"Gill nets and purse seines are used for catching Spanish mackerel in the vicinity of Key West. A few are caught with trolling lines, but the catch from this source is small."

The traditional method of fishing for mackerel in the Keys is netting, and according to commercial fishers, there is very little bycatch. Most felt that with responsible regulations, the population can remain stable and the net fishery can continue. On the other hand, several people claimed that net fishing wastes fish. One person said he saw a boat load of mackerel thrown overboard because it could not be sold.

Other comments on mackerel were:

"The colder the winter, the more mackerel come into Florida Bay, the better the fishing. The mackerel need clean water and shrimp to eat."

"The Spanish mackerel are not in the Bay anymore. They used to be thick. They are not coming through the Bay and out the Long Key bridge like they used to because of the dirty water. Now they are moving to the west. During the 1992/1993 season, boats had to go to the west coast or off Key West to catch the mackerel."

"We no longer have the huge schools of mackerel off Marathon and in Florida Bay like we used to have. They are a clean water fish. We no longer have the big mackerel runs. Spanish mackerel is one of the fish most influenced by the algae blooms."

"Prior to 1981, 60-70 thousand pounds was a common catch for the net boats. Now you no longer can do that off Marathon and Florida Bay. You can still do it off Key West where you still have clean water."

TUNA, ALL SPECIES

NMFS TUNA LANDING DATA 1990 (in pounds)	
Bonito	2500
Skipjack	109
Yellowfin	4108
Bigeye	160
Blackfin	31120
Unclassified	2098

Information on tuna landings in Monroe County is limited. Prior to the establishment of the State trip ticket system (circa 1987), landing data on tuna were virtually non-existent. Throughout the 1970s, records show small amounts of bonito were landed in Monroe County. The State trip ticket system created detailed landing information and reliable information was available by 1990.

The tuna fishery in the Florida Keys is not a commercially important fishery. Since there are no large schools of tuna, and the tuna move through the area quickly, a commercial harvest is not cost-effective. Most tuna sold by the commercial fishers are incidental catches.

A large portion of the tuna landed in Monroe County is from the charter fishing fleet. Within the last three years, tuna has increased as a target fish for charter and recreational fishers. Due to the "newness" of the fishery in Monroe County and the lack of a prominent commercial fishery, not many comments were collected.

The following comment represented the prevailing view:

> "There are very few tuna around. The catch is down 90 percent [in the State of Florida]. The main problem is the long lines and the demand by the Japanese. After the war [c. 1950], the Japanese, Koreans, and Russians introduced the large tuna long line boats."

Billfishes and Swordfish

The prevailing opinion on marlin and swordfish is that the populations have been reduced by long lines. Some interviewees felt that the species were making a slow comeback, crediting regulations.

Sailfish were once very common in the Keys and were heavily targeted for sport fishing. The population then started to decrease, perhaps due to the increase in charter fishing. The people interviewed reported that sailfish had increased in population and individual size since fishery management regulations were established. There also has been a concerted effort to promote catch and release fishing for sailfish.

> "A good day fishing in the old days was to catch four sailfish. That was all year round. Of course, there was no conservation then, so we just killed the fish and had a truck come pick up the carcasses, which were turned into fertilizer. Very seldom would you go offshore and not catch a sailfish."

> "Since size limits and landing limits were established, the fish are getting bigger."

FISH SPAWNING

Interviewees were asked if they knew the locations of historical or present spawning aggregations. A summary of comments on the location of past and present spawning sites appears in Table 4. Most

people said that many of the old spawning aggregations no longer exist due to fishing pressure. Some noted the disappearance of an aggregation, but could not identify the cause.

> "Cubera snapper used to spawn off Key Largo. It was fished out by the recreational fishermen."

> "In the mid to late 1970s, in March and April at Looe Key, there used to be a black grouper spawn. In June the nurse sharks are everywhere on the flats."

> "I have caught snowy groupers that had ripe gonads in May 1992, off Summerland Key in 850 feet of water. Black groupers spawn in April and May on the reef line off Big Pine Key."

> "Mutton snapper used to spawn in 60 feet of water at Western Dry Rocks from April to June. I am not sure if they still do."

> "Mutton snapper spawn at Riley's Hump and on the west side of American Shoals near Maryland Shoals."

> "There used to be an old mutton [snapper] spawn near Western Dry Rocks at Coalbin Rock/Vestal Shoals."

> "Hog snapper spawn January and February near Tortugas, in 60-70 feet of water."

> "Jewfish used to spawn near Maryland Shoals and Eyeglass Bar, east of the shipping channel, and also at Riley's Hump. Those areas were fished out. Now some spawning occurs off Key West on a wreck in September, and on the wrecks in the Gulf in August and September. I have observed jewfish [with] ripe [gonads] in the shallow nearshore waters in June."

> "Mutton snapper used to spawn at Western Dry Rocks. It was fished out. I have observed the spawn [of mutton snapper] at Riley's Hump in May and June. ...African pompano spawn on the Gulf wrecks. I caught some that were ripe in June 1992 in Rebecca Channel. ...Permit spawn in May on the wrecks and the towers in the Gulf. ...Amberjack spawn in April and May on the deep humps off Islamorada and Marquesas. ...Warsaw grouper spawn in June in 300 feet of water off Marquesas. ...Cubera snapper spawn on wrecks west of Key West in July. ...Silver margate spawn in April near Marquesas. I have caught triggerfish that had ripe gonads during April 1985 and June 1988 near Marquesas. I have also caught schoolmasters [snappers] with ripe gonads in June 1992 in Tortugas. ...Mangrove snappers spawn in July on the reef tract. I have caught kingfish with ripe gonads August 1991 in the Gulf."

> "Red drum spawn in the deep waters of the Gulf."

Besides the location and time of year of the spawn, some interviewees said that people should "give the fish a chance to spawn in order to help the future population of the fish." Many agreed with spawning season closures.

> "A lot of the spawning aggregations are being fished out. Historical spawns are gone now due to being fished out by both recreational and commercial fishermen."

> "Traditionally, during the spawn is when you fished for a certain species. The only spawns that still exist are the ones that used to be the 'undesirable' fish and the ones that are a distance from peoples' access."

> "I do not care for spawning season closures. The only good thing is that the price of the fish would not drop so bad. Right now, there is a drastic reduction in the price of the fish caught during spawning. The [large] amount of fish causes a market glut and it isn't fair to the resource. An example is mutton snapper, which might start out at $1.75 to $2.00 a pound for the fish before the spawning season. [then] would drop to $0.90 to $0.80 a pound."

SEA MAMMALS

Manatee (*Trichechus manatus*)

Throughout the Florida Keys, sightings of manatees have increased.

> "They are in the Keys more now. Prior to 1986, I never saw a manatee in Bahia Honda. Now it is a common sighting. Kids are seeing them more often now in the nearshore waters off Marathon."

> "I never saw a lot in the past, maybe two or three a year in [Florida] Bay [near Sandy Key and Rabbit Key]. I see a lot more now."

> "According to the old timers, they used to find manatee around Cape Sable and Little Madeira. It used to be very rare to see them down here [Lower Matecumbe Key]. Now it seems as though manatees are all over the place. They come seeking you out and are pretty tame."

Two people provided some historical information on manatees.

> "In the old days, manatees were killed for their meat, which was eaten, and their tusks, which were sold."

> "I have heard of manatee pens maybe used by the Indians or Conchs."

Old newspaper articles provided information about manatee pens. In an article written by Love Dean (1982), Charles Brookfield tells the story of "the Cowpens":

> "The early settlers in the upper Keys named this area [Cowpen Keys] for the manatee or seacow. Manatees were captured and then released there until they were needed for food. It was a perfect natural pen, for the deep water shoaled up on one side and was surrounded with a thick growth of red mangroves. On the other side, marl banks prevented the manatees from escaping. There was an abundance of underwater vegetation for the manatees to eat including 'manatee' grass. ...When it was time to slaughter one of these mammals, the men would all sail to Cowpens to get their share of the meat for their families."

Daniel Beard's document (1938) comments on the population of manatees in Florida Bay:

> "Manatees are found in numerous areas along the west coast, inlets in Key Largo, and various reports have been made of their occurrence all through the eastern part of Florida Bay. In the Park, upper Florida Bay is the most important area including the various streams and estuaries bordering it. It is felt, though, from what little information is available, that the inner bays on Key Largo and probably around the Madeira Bay section, contribute as 'nursery' areas for the young manatees."

Porpoise (Bottlenose dolphin)
(Tursiops truncatus)

Several people commented on the decline of porpoise sightings:

> "There are less porpoises seen in the wintertime off Key West now versus the past."

> "Porpoises haven't been in the Bay much since the blooms started. They used to be all over the place."

> "I see more porpoises near the Seven-mile Bridge and in the inshore waters. They used to be plentiful in the Bay. I think they are chasing or following the bait."

Caribbean Monk Seals

Caribbean monk seals were once common in the Florida Keys, near Dry Tortugas and Key West. Old log books of voyages and shipwrecked groups from the 1500s to the 1700s list seal as a major food source. The last record of a seal in the Florida Keys was of one killed in Key West in 1922. The Caribbean monk seal has been considered extinct throughout the Caribbean, the West Indies, and Florida since 1952. No one interviewed reported seeing one.

Sea Mammal Strandings

One person provided a great deal of information regarding sea mammal strandings in the Florida Keys:

> "From the Channel 5 Bridge to the Barracuda Keys on the Bay side ...is the catch-all area. Animals that strand themselves in the Tampa, Naples area and are pushed back offshore end up in that area. ...The public is better educated now, so strandings are reported more often. This is all due to the increased amount of boat traffic, more eyes on the water. Instead of pushing them back in the water, the west coast people know to keep the animal wet and wait for a professional to treat the animals. ...Mammals mostly strand for a reason; they follow the leader, are sick and/or confused, or they just had a bad day. Pilot whales strand in dozens, two to three days apart. ...I have observed a direct correlation to the number of strandings and the Navy bombing off shore of the Keys. After the Navy bombing, a lot of pelagic species stranded themselves [melon headed whales, minke whales, fin whales]."

SEA TURTLES

In March 1971, the State of Florida set a 41-inch carapace size limit on green turtles harvested. Since green turtles with a 41-inch carapace were seldom found off the Keys, the legal harvest of green turtles was no longer profitable.

People offered a variety of comments on the population of sea turtles. Some interviewees said there are not as many sea turtles as there were in the 1930s and 1940s. Several people said sea turtles are not seen in Florida Bay anymore. Most, however, agreed the population in the ocean is starting to come back and there are more sea turtles now than five to ten years ago.

> "Turtles are on the upswing since protective measures were established. Before Hurricane Andrew [1992], I saw 20-25 loggerheads a day in Florida Bay and the West Cape area, two to three hawksbills a day, and four to five green turtles a day. I have only ever seen one Kemp's Ridley turtle, and that was

in the Gulf Stream. It was a little one sitting on the weed line."

One person described a spawning area for leatherback sea turtles:

> "There is a leatherback spawning area due west of East Cape, almost due north of Key West, under the tip of mainland Florida, in approximately 38 to 42 feet of water. One day I counted 42 of them in the area. When mating, they look like two upside down boats on top of each other. They have always been there February and March, except this year they did not show up [1993]. One year when we had a severe winter they came late, sometime in March to May."

One person claimed he first noticed tumors on sea turtles sometime around 1981 or 1983.

> "It seems as though the [fibropapilloma] tumors on the turtles only showed up in the last ten to 12 years. I do not recall seeing them prior to then."

BIRDS

Several interviewees from the middle Keys said they have observed a significant decrease in the bird life in Florida Bay, while interviewees from the lower Keys and Key West reported seeing an increase in the bird life in the backcountry area and off Key West in the past few years. According to the interviewees, the algal blooms and poor water conditions in Florida Bay have displaced the baitfish and the bird life to the west, and the birds are moving with the bait fish.

> "There are more pelicans and ospreys in the backcountry [of the lower Keys]. Too many cormorants. There is plenty of food for [the birds] in the backcountry. There was a recent pinfish explosion."

> "There has been a whole change in bird life in Florida Bay due to the lack of baitfish, food. Ocean-going seabirds [have been] highly affected. I find gannets floating dead on the water. I never had one land on my boat until this year; the bird was in a weakened state. April 1993, I took a film crew out to the dead zone area [west Florida Bay]. In one day, we saw two dead cormorants, two live seagulls, and two live cormorants -- that's it."

> "There used to be massive flights of ducks and birds near East Cape. They disappeared. The area used to be full of them. I don't ever remember seeing white pelicans at the Cape in the past, but they are there now. ...In the early 1980s, there was a big increase in the number of osprey nests. As long as can remember, there were always a bunch of ospreys around Islamorada. ...In the past, birds were never really around the docks. They were not people-friendly. Now they hang out waiting and expecting a handout. They have adapted extremely well to people."

> "Watch the bird life. When they diminish, something is happening to the system. As the [amount of water was decreased], the bird life disappeared in the lower Everglades and Florida Bay. There used to be a lot of long-legged wild turkeys in the 'glades. Spoonbills and white Ibis used to be all over the flats feeding in the 1950s, then they started disappearing because the food supply was disappearing. ...Everything is being pushed out. White pelicans used to be all over the

> place, same as the spoonbill. I haven't seen a white pelican in over a century. Spoonbills used to nest near the Intracoastal Waterway along Jewfish Creek. The last two years they have not been there."

Several people said they observed many birds dead or dying in the water and along the shoreline off Key West.

> "In 1990, water bird deaths doubled. More of them in the Key West area. The dead and dying found were weak from apparent lack of food."

TABLE 4: Past and Present Spawning Observations

MONTH	SPECIES	LOCATION
January	Hog Snapper	near Dry Tortugas
	Red Grouper	near Key West and Dry Tortugas
	Black Grouper	near Dry Tortugas
	Black Mullett	not stated
February	Hog Snapper	near Dry Tortugas
	Yellowtail Snapper	off Islamorada
March	Tarpon near Ninemile Bank	
	Black Grouper	off Big Pine Key on the reef
	Silver Margate	near Marquesas
	Yellowtail Snapper	near Tortugas
	Amberjack	off Islamorada and Marquesas
	Silver Mullet	not stated
	Mutton Snapper	off Key West
May	Mutton Snapper	off Key West and Dry Tortugas
	Tarpon	near Ninemile Bank
	Black Grouper	off Big Pine Key on the reef
	Yellowtail Snapper	near Key West and Dry Tortugas
	Mutton Snapper	near Dry Tortugas
	Permit	in the Gulf
	Amberjack	off Islmorada and Marquesas
June	Mutton Snapper	near Key West and Dry Tortugas
	Mangrove Snapper	on the reef
	Jewfish	in shallow waters
	Warsaw	off Marquesas
July	Cubera Snapper	near Key West
	Mangrove Snapper	on the reef
	Jewfish	off the lower Keys on the reef
August	Jewfish	in the Gulf
September	Jewfish	near Key West and in the Gulf
December	Black Grouper	near Dry Tortugas
	Black Mullett	not stated

PART II: INVERTEBRATES

SPONGES AND THE SPONGE FISHERY

The three varieties of sponges sold in Key West are sheepswool, yellow, and grass. The sheepswool grade is the most valuable. Sponges harvested from Keys waters were used by the inhabitants of Key West since its settlement in 1822. Keys sponges did not gain commercial value until 1949, when William Kemp sent a boatload of sponges to market in New York. Before 1849, all commercial sponges came from the Mediterranean.

Sponges were plentiful in the Keys and available near Key West. These beds were in shallow water, but as they became exhausted, the sponges were then taken from ever deeper water. Sponging in the Keys was accomplished with a three-pronged hook attached to a pole, an invention attributed to Benjamin Archer. The early poles were only 12-15 feet in length, but poles up to 50 feet became necessary as sponging moved to deeper waters.

In the late 1800s, large motherships, such as a two-masted vessel, towed a string of dinghies to the sponge grounds. Teams of spongers would then pole the small boats over the bottom, locating and pulling the sponge.

Until the early 1890s, Key West had a monopoly on the sponge business in the United States. There were about 500 men and 130 boats of all sizes and varieties involved in sponging. Sponges played an important role in Florida's fishing industry, netting the sponge fishery nearly a million dollars per year in the 1890s. In 1891, a small sponge market was established in Tarpon Springs.

SPONGE AQUACULTURE ON SUGARLOAF KEY

In 1901, Sugarloaf Key drew the attention of Dr. H.F. Moore, head of the Bureau of Fisheries, who established a small station to experiment in the controlled raising of sponges. Wild sponges were cut up into small pieces and attached to stone or cement discs. It was estimated that it would take five years for a sponge to grow to maturity. These experiments were carried out over a period of several years in the bays of Sugarloaf Key. At that time, Sugarloaf Key contained two large land-locked bays, which were bisected when the railroad was built. Around 75 percent of the planted sponge cuttings matured.

About 1910, Charles and George Chase bought most of Sugarloaf Key including the sponge stations, and formed the Florida Keys Sponge and Fruit Company. Each fall, once the weather cooled, the schooners and dinghies were sent to the Marathon area to collect natural sponges. Every two weeks, launches took the sponge pieces from the schooners to Sugarloaf Key for planting. Great care was taken to keep the sponge pieces wet and alive. The sponges and disks were placed in at least three to four feet of water.

Poachers stole the growing sponges as fast as they matured. In 1916, the Company was forced to sell the farm due to the outbreak of World War I, which caused the owners' finances to be frozen in English banks. The land was then sold to a Mr. Perky. In 1917, a sponge disease reached the lower Keys and destroyed both the natural, but also the cultivated sponges in the northwest and southwest Sugarloaf Bay areas.

The Florida sponge industry never met the demand in the early to mid 1900s. Beard's Everglades Document lists the landings of sponges in 1935 as: 15,000 pounds of grass sponges, 24,600 pounds of yellow sponges, and 47,100 pounds of wool sponges with 1/3 to 1/2 of the yellow and wool sponges coming from Everglades Park waters. A combination of the sponge blights of 1939 and 1946, heavy harvesting that caused the sponge beds to became depleted, and the introduction of synthetic sponges reduced sponge production by the early 1970s.

Beard's Everglades Document (1938) describes sponging in Florida Bay:

> "Sponging is carried on in Florida Bay, the lower Florida Keys and along the reef on the Atlantic side. There is less sponging in upper Florida Bay than in other places. Sponging depends on the water. If it is clear, the sponges can be taken by using long poles with hooks on them (the legal method in Monroe County). Clear water is found in Florida Bay only when there has not been a great deal of rain or wind."

In December 1991, all sponge harvesting was stopped in Biscayne National Park. Now, most commercial fishing in the Keys occurs west of Bahia Honda in the lower Keys.

Interviewees were asked if they had noticed an increase or decrease in sponges. They were also asked for any other information about sponge species and about changes in the commercial sponge industry.

Several interviewees from the lower Keys and Key West noted an increase in the number of spongers. They claimed the number of liveaboard sponge boats increased markedly from the mid-1970s to late 1980s. Sponge harvest in the lower Keys and Key West also increased, and some noted an especially large jump about four years ago. Other interviewees noted declines in the populations of sponges in the lower Keys.

> "I have noticed an increased number of spongers in the lower Keys since 1990/1991. I have also noticed a decrease in sponges [in the lower Keys at about the same time]. More species are targeted now and sold at the flea market."

One sponger offered the following information:

> "As the prices [of commercially important sponges] increased, more people got into the sponge profession, especially since yellowtail [snapper] and other fish prices were so low. We're also seeing more old timers collecting sponges now. The price has increased so much due to the Mediterranean blight. ...In the area called 'the lakes' off Key West is where you get good rollers. The sponges in the Big Pine Key area are softer sponges. There is a small curio market for tube sponges. Overall the size and the population of commercial sponges are steady and doing fine."

A few people said spongers work an area too hard, taking every kind and size of sponge from that one area. In areas "worked over" by spongers, fishers have described the water as going from crystal clear to murky, with the only difference being the lack of sponge in that area.

Several interviewers expressed concern about environmental impacts they associate with sponging.

> "With the increase in spongers, I have observed a decrease in sponges in an

area and a subsequent lack of water clarity [in that area]."

"They [sponge motherboats] run aground, create their own channels, tear up seagrass areas, and plow right through the shallow water areas."

Several people noted that sponges in the nearshore waters of the upper Keys appeared fine.

"[The sponges] seem to be reproducing fast enough to keep up with collection without adverse impacts."

One person had observed a decline in stinker sponges in the nearshore waters on the bayside of the upper Keys. Another person said that the rough tree sponge was disappearing offshore.

There was much talk of the sponge die-off caused by the 1992/1993 algal bloom near Arsnicker and Buchanan Keys in Florida Bay. In the area of the die-off, a strong sulfur odor hung in the air. One person observed some sponges "growing back in those areas where you have good water movement, flow."

The same event had other effects. Another person observed a sponge die-off five miles north of Grassy Key from November 1992 to January 1993. Several people also saw many floating dead tube and barrel sponges in Florida Bay waters during the same time span. One person saw many dead loggerhead sponges in Florida Bay and on the reef side of the Seven-mile Bridge where the bloom had passed through. This person felt that the die-off was due to poor water quality coming from Florida Bay through the Seven-mile Bridge.

Many others had observed sponge die-offs and attributed them to various causes.

"The last ten months [since May 1992], barrel sponges have been dying on the reef off of Marathon."

In the middle Keys, one interviewee observed a film of brown slime covering the sponges last year (1992). Another person saw sponge decline in an area on the oceanside of the east end of Lower Matecumbe Key.

"This area has changed a lot. There are a lot less sponges now. In the 1940s there were a lot of sponges in that one area. Not sure what happened."

One person said there was a sponge die-off on the bay side of Grassy and Long Keys in 1983. He felt this was caused by hot weather and warm water, and the die-off primarily affected the yellow and wool sponges.

In the lower Keys, several people observed a sponge die-off near Big Pine Key. They saw one on the west side in the summer months of 1978 or 1979, and on the east side of the island in December 1992. The west side die-off primarily affected the zestra barrel sponges and the large sponges in Big Pine Key shoals. One interviewee saw a sporadic sponge die-off in the mid to deep reef areas off Big Pine. Yet another person observed many dead sponges at Boca Grande Channel, west of Key West, in the past few years.

CORALS AND CORAL REEFS

The collection of coral became illegal in State waters in the early 1970s. Coral harvest was unrestrained in federal waters until 1976, when the harvest of fire coral, hard coral, and sea fans was prohibited in federal waters under the Outer Continental Shelf Lands Act. In 1981 or 1982, regula-

tions were established to manage and protect corals and coral reefs in federal waters.

Interviewees were asked if they had noticed a change in coral coverage. They also were asked to describe symptoms of the loss and what they felt might have been the cause.

Several people commented on damage to areas caused by coral collecting. They primarily mentioned the disappearance of staghorn and elkhorn coral formations as a problem due to coral collectors.

> "A lot of coral collectors worked out of the Marathon area. They targeted elkhorn, which there used to be a lot of off Marathon before the collecting days, staghorn, and brain corals; very few took fire coral."

One interviewee said the reef off Marathon was hard hit, including the area called "Pillar Patch," southwest of Coffins Patch off Marathon. This person said that in the 1950s, all the shops and divers in Marathon agreed not to fish around the great stand of pillar coral. Then ...

> "The pillar coral looked like a castle with flags of colorful fish. In the late 1960s or early 1970s, someone in the dive shop said that the pillar coral patch had been 'sold.' The next time I went out to the site, the 'buyer' had already chopped off all the pillars and sold them."

One person also said collectors ruined the coral areas off Sombrero and Looe Keys. He said Sombrero Reef once had a forest of staghorn coral before it was all collected.

> "I was there [Looe Key] before it was a sanctuary [in the 1950s/1960s]. There used to be a forest of staghorn coral on the east side, on the first three fingers of the spur and groove. [There was] staghorn growing on top that was six feet tall, like a forest. I did not visit the site again until the late 1970s. All of the staghorn was gone."

It is not known for certain if the disappearance of staghorn coral at Sombrero and Looe Keys was due to coral collecting. Part of the disappearance could have been from weather-related conditions, in particular, a severe cold front. Since the coral collection laws were enacted, many interviewees claim staghorn coral has increased on some of reefs.

Weather, in the form of cold fronts, calm hot spells, and hurricanes, plays an important role in the life of corals in the Keys. Several people noticed that the large staghorn coral area in the shallow water along the east side of Loggerhead Key (in the Dry Tortugas) was killed during a severe cold weather spell in 1977. Another person observed a major decline in staghorn coral at Looe Key at the same time, possibly from that same cold front. According to another interviewee, a major cold front in the early 1970s killed many shallow water reefs throughout the Keys, particularly the staghorn coral areas.

Hurricanes -- besides fragmenting and moving corals -- also cause the movement of sand and silt. One interviewee said that one month after Hurricane Donna, there were six inches to one foot of "gooey" silt covering the corals off Lower Matecumbe Key. Both Hurricanes Kate (1985) and Elena (date unknown) fragmented the corals in the Keys, particularly staghorn and elkhorn coral, in shallow areas. Several people observed that some coral areas impacted by hurricanes "came back," while others died.

A few interviewees noted a decline in the number of sea fans at nearshore and

patch reef areas, especially in the vicinity of Long Key and Lower Matecumbe. They believed tourists were taking them. Also, one person said that the patch reefs off Long Key were being impacted by the over-collection of invertebrates and shells, by recreational divers and snorkelers. The areas described are offshore of Channel Five and Channel Two, which are major water exchange connections with Florida Bay.

Another person, a scientist, noticed that a nearshore flats area near Conch Key and the west end of the Long Key Bridge on the northeast side of Conch Key, were once rich *Porites* beds. He said that 90 percent of the *Porites* (also known as finger coral) was dead and had turned to rubble in 1992. The adjacent seagrass beds all seemed fine and had not changed. Where the *porites* had once grown there is now *Cladocora*, a bushy hard coral. This change occurred within one year. He also observed many large sea urchins there this year (1993).

Many interviewees said that, within the last four or five years, they have observed the reef "going downhill fast." They described less coral and more algae growth. Some related this directly to the sea urchin die-off of 1983, because they started noticing the effects six to eight months after the die-off. One interviewee, referring to the sea urchin die-off and the decline of other reef "grazers," said:

> "...[there is] more dead bottom on the reef now. Everything has a growth and something to take care of the growth. When you take off the something from the reef [grazing species], algae takes over and kills it."

A common observation throughout the Keys was that algae was growing without control on the reef and has been slowly overtaking live and dead coral areas. Off Key West, divers have seen more *Wrangia*, *Dictyota*, and "stringy green" algae on the reef. In Calder Channel (north of Key West) a few people noticed a decrease in live coral and an increase in "brown moss [algae]." One person said he observed some coral areas off the Channel Two Bridge (middle Keys) being "buried, and taken over by *Halimeda* algae," two years ago.

One person described the reef off Lower Matecumbe Key as "scummy looking." "The coral looks all beat up with slime covering them." This person felt water was not circulating through the area as in the past.

One person said that, off Marathon:

> "...the reef doesn't look as healthy, not as brilliant in color. It's dull looking now. Something isn't right, but I do not know exactly what. I see a lot more dead small corals [now] in the near-shore waters, all kinds."

Another common observation was increased silt. Some people said they have watched the reef and the coral turn gray over the past five to seven years. One person said, off Key West, "the reef looked dusty, like there was a fine layer of silt covering the corals and the reef tract."

Some people have watched some smaller patch reefs become buried in silt or "disappear." One Big Pine Key resident said 15-20 years ago (between 1973 and 1978), heavy silting occurred in Spanish Harbor (east of Big Pine Key), which heavily impacted all the fire coral in that area.

Several people said the reefs were spectacular in the 1950s, but lack their pristine quality now. There are fewer live corals, and their colors are not as vibrant.

> "...it's hard to figure out why, when there are so many variables -- natural, disease, cyclic, manmade."

Some people said they started to see a change, especially in the middle Keys, in the late 1970s. They noticed a "50 percent decline" in the number of hard and soft corals. Even off Key West a few people started noting the reef decline 20 years ago (1973). Two other interviewees said there is not as much diversity on the reef as there was in 1977.

The most common statement throughout the Keys, made by a variety of user groups including long-time dive captains, was:

> "We are loving the reefs to death. Any marked reef is doomed. There are too many people."

Most people said the biggest change over the years has been increased development, with a corresponding increase in reef degradation. Most long-time residents have observed a steady increase in the number of people using the reef since the mid-1970s. Most also observed a lot of user damage to the corals and the reef system.

> "...hardly a patch reef exists now that doesn't have a scar."

Many interviewees noticed an increase in physical damage on the reef from concentrations of recreational divers and boats in one area. One person from the lower Keys said the most heavily impacted areas were Looe Key and the reef line from Eastern Dry Rocks and Rock Key to Sand Key off Key West. This latter area off Key West is a popular destination for tour boats that deliver hundreds of snorkelers and divers each day. Several people said reef degradation was not as noticeable between North Boca Grande and Marquesas Key, an area not heavily targeted by tour boats.

When interviewees were asked about specific causes for damage to corals and the reef system, many made comments about the advance sport lobster season (or "mini-season"). Several people said they have seen these individuals "dismantling reefs" to get lobster. Throughout the Keys, long-time residents and fishers said the damage done in those two days "was appalling."

Coral Bleaching

Most interviewees who dived or snorkeled knew what coral bleaching was. They were then asked if they had observed coral bleaching, when and where they had observed it, and whether the corals had come back to their normal coral coloration.

Two people, one from Key Largo and one from Marathon, said coral bleaching events seemed to coincide with the *Diadema* (sea urchin) die-off. In their observations, the coral did not come back.

> "...tremendous amount of bleaching observed after urchin die-off, never saw it before then off of Marathon. The coral did not come back."

> "The elkhorn and staghorn coral at Carysfort [reef off Key Largo] got bleached out and did not come back."

One person said he first saw coral bleaching about ten years ago (c. 1980s) off Big Pine Key. He was unsure if the corals had "come back," but thought they did. Another person, a diver in the lower Keys, said he saw coral bleaching for the first time in 1975/1976 on some patch reefs in Hawk Channel.

One person noticed coral bleaching on some coral heads west of Key West in the late 1980s. Several people observed coral bleaching and hot water conditions off Key West in August 1993.

One interviewee offered the following chronology of events regarding coral bleaching. His timetable summed up the observations of many other people.

> "At the end of July 1983, coral bleaching was observed from Looe Key to Western Dry Rocks. The Sambos and Sand Key [south of Boca Chica and Key West respectively] got hit the worst. Only three percent of the bleached coral died, the rest recovered. At the end of August 1987, coral beaching was observed throughout the Caribbean, and by the end of October 1987, it was seen throughout the Indo-Pacific. Most of those corals recovered.
>
> "In the summer of 1989, there was a minor bleaching event in the Keys that hit mainly the lettuce coral. This phenomenon also occurred in Puerto Rico and Lee Stocking Island [southern Bahamas] where lettuce coral was the primary coral species affected.
>
> "In August 1990, there were some massive coral bleaching events that appeared to be related to the low oxygen content in the water due to the presence of very hot water. The corals went from yellow to stark white very quickly. During this event, the coral bleaching also hit the inshore patch reefs. Sixty-five percent of the fire coral died.
>
> "In the last few years there has not been a big problem with coral bleaching. In August 1993, coral bleaching, along with hot water, was documented off Key West."

Black Band Disease

Interviewees were given a description and a photograph of black band disease. They were then asked if they had observed black band, when they observed it, and where.

Several people said they saw black band disease for the first time on corals at Looe Key (south of Ramrod Key). One person noticed black band disease at Looe Key in 1986. Most people did not know if the coral had recovered or had died. Another person said he knew the coral died.

One person claimed the Sombrero Reef area off Marathon had a major outbreak of black band disease, and the disease was continuing to attack this reef area. This interviewee was not sure when he first noticed the disease, but said it was getting worse. He also saw coral bleaching in some areas where there was black band disease.

Off the lower Keys and Key West, several people said they first saw black band disease at the Sambos (south of Boca Chica Key) about eight or nine years ago (1985 or 1986). A few saw some of the corals impacted by black band disease "coming back" in the last two years. Another person observed a lot of black band disease in 1992 at coral areas near Jewfish Basin (north of Boca Chica Key) in the Gulf of Mexico.

Favored Dive Sites

Daniel Beard's report on the Everglades National Park project (1938) refers to "the Atlantic Marine Gardens" (coral reefs). Mr. Beard states that Commander C.C. von Paulson of the U.S. Coast Guard Air Service,

"...claims that the best coral formation is found within the park boundaries at Carysfort Reef. ...The owner of a gasoline station at Key Largo claims that the most attractive reef formations are at Grecian Shoals. ...He said that it is inevitably the case when fishermen are taken out to Grecian Shoals that more looking is done than serious fishing."

The report also says that Mr. Al Pflueger, a prominent taxidermist in Miami in the 1930s, felt that "the best place to collect fine coral specimens and ornamental fishes is off Key Largo."

Interviewees were asked to describe their favorite locations. Most of the people picked sites with clear water and those not frequented by other people. A few people said they enjoyed trying new places and sought new and interesting coral areas.

"Turtle rocks [off north Key Largo], because it is still close to being pristine -- probably because of lack of users and visitors."

"Coral Patch, also known as Pillar Patch [south of Marathon]. It was a patch of old reef area that broke off of the end of a coral system and became its own reef. [It was my] favorite dive spot in the 1950s. The site is dead now."

"Coffins Patch [south of Marathon]. There is a good stand of pillar coral at the western end of Coffins Patch. This area is taking a beating from too many visitors and people dropping their anchors."

"Looe Key, because it has the best mix of habitat in a small area."

"Looe Key and a patch reef near No Name Key. The patch reef has a large brain coral with lots of angelfish and juvenile fish swimming around."

"West Washerwoman [south of Saddlebunch Key]. There is a half to 3/4 of an acre of staghorn coral in approximately six feet of water. Also, on the oceanside there is a good stand of pillar coral."

"Maryland Shoals [south of West Washerwoman]. Good stand of pillar coral, approximately 12-14 feet tall."

"Boca Grande and Eyeglass bar [near Marquesas Key] . Interesting variety of fish and the water is usually clearer than other areas."

"The reef around Cosgrove [southwest of Marquesas]. Up until the past year, the water always used to be clear. [There is also a] stand of pillar coral."

"Tortugas area has a lot of large brain coral heads."

"Pulaski Light [north of Tortugas]. There are large areas of flower coral."

CRUSTACEANS

For statewide landing information on the importance of the crustacean fisheries, see Table 2.

Lobster and the Lobster Fishery

Lobster Landings		
NMFS landing data, high year	1989	6,905,768 Lbs.
NMFS landing data, low year	1983	3,571,393 Lbs
Beard Everglades Document	1935	168,500 Lbs
Dept. of Commerce Report	1918	345,518 Lbs

In the Florida Keys, the spiny lobster (*Panulirus argus*) is known locally as "crawfish." When out pulling traps and harvesting the lobster, most fishers say they are "fishing for crawfish."

The harvest of lobsters has been regulated since 1919. A report by the Department of Commerce (1923) provides an historic view of the business:

> "The only fisheries which have shown noteworthy developments during the last half century are those of the spiny lobster and the Spanish mackerel. ...The crawfish is found close to shore, and most of the fishing is carried on within a mile of land. ...Fishing lines are always kept aboard, so that if crawfish fishing proves unsuccessful the fishermen may return to port with a fare of fish. ...Three methods are employed in catching the crawfish: trapping, bullying, and striking. ...The traps are handmade and are built of heavy galvanized wire. ...Stone crabs and fish are often caught along with the crawfish. ... 'Bully' fishing for crawfish is done chiefly at night. ...The crawfish is taken at all seasons of the year, but the period of greatest abundance is from November to June. ...To conserve the supply of crawfish, the State of Florida has enacted a law, approved May 23, 1919, and effective for the first time during 1920, protecting the crawfish during the principal part of its spawning season. ...between the first day of March and the first day of June of any year. Salt-water crawfish may be caught or taken at any time for the purposes of bait, for catching fish, or for purposes of propagation or research."

The commercial market for lobsters was not large in the early 1900s. Lobster were sold locally for food, but were mostly used for bait. In *Outhouses to Computers* (1989), Willy Roberts describes lobstering off Key West from 1914 to 1928.

> "The blacksmith also made a double-pointed spear with barbs on each point similar to the end of a fish hook. A socket on the other end was to allow mounting of the forging on a long pole. It was called a 'grains' and was used to strike crawfish when one would need bait to fish or wanted crawfish to eat. Most everyone would catch their own crawfish to be sure they were fresh. Crawfish were considered poisonous if not cooked alive."

One interviewee talked about lobstering off Islamorada:

> "In the 1940s, during the closed season, we would be paid double the money to poach the lobsters. We would bully net for crawfish at night on the flats in the Bay [Florida Bay]. In the old days, we also used metal ice cans for lobster catching. We used to buy the old rusted ice block forms and put them in the water with no buoy. Soon it would be full of lobsters for the taking."

In *Charlotte's Story*, Charlotte Neidhauk describes the lobster traps that she and

her husband built and used off Elliot Key in 1934 and 1935:

> "Now the crawfish season was about to start. ...We were all anxious to see the first complete trap. Russ and Doc had made the framework for several [traps] but needed other material. ...We needed the dropping roots of the Red Mangrove trees to complete the traps. When young, [the red mangrove roots] are spongey and quite flexible. Using them instead of lathes we saved money and didn't have to travel for them. Another feature was that they required no pre-soaking. Only a minimum of ballast was needed, just a rock or two in each trap. ...Now we had 40 traps and each caught at least eight legal sized ones [lobsters] a day."

The shape of the lobster trap has changed many times. One person described the first traps he used, which had two entrances and were called "Z" traps due to their shape. In 1938/1939, this person began using pyramid shaped, wooden traps that had a funnel at the top. The square traps became popular around 1948-1950.

Trap buoys varied in earlier days. Some were plastic gallon jugs with three-foot high flags on them. The problem with the flags was that people used them for target practice. At least one person used dry coconuts for buoys and some used glass clorox bottles.

> "In the old days we used glass clorox jugs for buoys that had a cork top. We would buy them off the garbage men. Didn't have nylon or polypropylene line; used manilla rope that was capable of being hand pulled."

The people interviewed and historical references both confirm there have always been "bad years" for lobster.

> "In 1926, I couldn't catch enough lobster to make a stew. It was a bad year off the upper Keys. In the 1940s, they were thick all over the place. Lobsters have cycles."

> "In the 1930s, there were no crawfish in Key West."

> "A man who was a third generation lobsterman told me that from 1932-1935 crawfish left the Keys completely for no reason. They come and go."

> "Around 1968 and 1970, [we had] bad lobster years. Couldn't make enough to exist."

Several interviewees also mentioned the mass movement of lobster in relation to weather, or possibly to spawn.

> "I saw large crawls and spawns at Margaret Fish Shoal off Elliot Key in 18-20 feet of water, once in October 1926, and also in 1947 or 1948. Thousands of them [lobsters] walking day and night, in lines one after the other like a parade."

> "Crawfish will march forward in a column across the flats into the deep channel and will be gone for months. The march I watched took seven hours."

> "Crawfish swim great distances backwards. I saw big 'red shoals' in 1938 off Key West. [You] would think there was a big shoal out there, but it was actually a solid bed of lobster swimming. ...Once, off White Street Pier [south side of Key West] there was a big haul of lobster [due to a mass crawl]. Three people caught 1000-1500 pounds of

> crawfish just by picking them up. I threw at least 5000 pounds of them back into the water because they were undersized. This was all done next to the pier. Next day people were using cast nets to catch the lobster."
>
> "In 1946/1947, during the first six weeks of lobster season, we had two big hurricanes go through the Key Largo area. They wiped out everything including all of the traps. Right after the hurricanes there was a big run on lobster."
>
> "Right before a hurricane was coming, the lobster would be all over the place; afterward, they were gone. They head out to deep water."

In *Charlotte's Story,* Neidhauk noticed a correlation between lobster catch and the arrival of the great Labor Day hurricane of 1935:

> "September 1st, 1935, ...this is the first time no one caught any fish [and lobsters]. ...The third boat to which we carried the [hurricane] warning was Captain Wm. Reno Russell's sailboat. He said that he had seen signs to indicate bad weather was brewing and was grateful for the warning. 'When you see crawfish moving in the daytime, heading for deeper water, it is most unusual. They are a nighttime creature.'"

One interviewee from the middle Keys said fishers were paid five cents per pound for lobster in 1941. There were never more than 25,000 pounds sold in a year, and those mainly went to local people. Another person said that in the early 1930s the lobster fishers in the Miami area and the upper Keys went on strike for more money. The price went from three cents to five cents per pound. By the late 1930s, the price was fifteen cents per pound in Miami. More people started lobstering in the mid-1950s once the price got to twenty-five cents per pound, and mechanical pullers started being used.

From 1950-1970, trapping was done primarily in Hawk Channel. In the mid to late 1960s the first traps were placed in Florida Bay by Florida Keys fishers. In those days old timers claimed there were no lobster in the Bay, and that lobster could only be caught on the reef, in the Channel, and under the bridges in the nearshore waters. Lobstering in Florida Bay was not very popular until the mid-1970s.

In the 1960s many lobster were caught in international waters, then sold in Monroe County. When the Bahamians closed off their waters and the Lacy Act (c.1981) made it illegal to sell Bahamian fish in the United States, many lobster fishers moved their traps back into Keys' waters.

> "A lot of guys in the Marathon and upper Keys area used to fish the Bahamas/Cay Sal Bank area. When that area was closed and the closure was enforced, all of those people moved their operations back to the Keys, which caused an increase in the number of traps in the ocean [here]."
>
> "There were so many traps in the water that they crowded five feet apart, and so thick they presented a navigational hazard. Boats tangle in trap lines, fouling propellors, breaking lines, and causing lost or damaged traps."

Methods of lobstering in the Keys vary among geographic areas. The upper Keys lobster fishers fish mainly on the oceanside; they use fewer traps, pull the traps more often, and fish in shallower waters than fishers in Key West. Lower Keys fishers use fewer traps than Marathon fishers, move

their traps around more, and use bait more often to catch the lobsters.

Most lobster fishers in the middle Keys also trap for stone crab. The Marathon lobster fishery is based more on the migration of the lobster, hence traps remain longer in one spot and more traps are needed.

Many interviewees said the drug trade and its fast wealth caused more traps to be put in the water, bigger boats to be used in the fishery, and a change from gas to diesel engines, which allowed people to fish farther out from shore.

Several people said changes in Florida Bay have affected the lobster population and lobster migration patterns.

> "The fresh water caused the fish and lobster to move to the west."
>
> "In the late 1970s, in the Middle Cape area, the bait cup in my traps would be full of just metamorphosed larval lobster. Now, do not see them. We lost that nursery."
>
> "1986/1987 was a good year for crawfish in the Bay. 1987/1988 was a phenomenal year. 1988/1989 was the last good year in the Bay and then in 1989/1990, the production went way down. I used to have 74 percent of my traps in the area now known as the 'dead zone'. The last four years, production from my traps in Florida Bay has dropped 30 percent. Seems as though everything is moving to the west. Before the Bay went to hell, August used to be the best month for lobstering in the Bay, but not in the last three years."
>
> "Seeing more juvenile lobsters in areas where you never saw them before. It used to be that the first real cold front would cause the lobsters to start walking toward the ocean through the Long Key bridge. For the past three to four years, it has not been so."

One commercial lobsterman from Key West provided the following comment:

> "Always had cyclical patterns in catch but what is happening now is different. Lobster caught at Tortugas are now much larger lobster. They are caught near the 300 foot curve. They have always been there. It's hit or miss whether you catch them. Some years you catch none....The lobster that used to be in Florida Bay go to Rebecca Channel and Marquesas Keys."

TRAP NUMBERS

Lobster fishers were asked how many traps they owned, and whether that was an increase or a decrease from previous years. Also, they were asked how many traps they added each year, why they added them, and what their average catch per trap was.

Most people said the catch per trap has decreased greatly. Fishers use more traps and leave the traps out longer to catch the same number of lobster as in the past. Some interviewees said they are also putting out more traps to keep up with everyone else. One person said the biggest increase in the number of traps occurred in the early 1970s.

> "In the old days it was the law that each person could only have 200 traps. Then it changed to 600. I caught more crawfish in the old days with 600 traps than people do now with 4000 traps."
>
> "I fished the reef off Marathon in the 1950s and only used 250 traps, which I pulled every day. I moved them

around the reef. In 1972, I had 500 traps."

"From 1972 to 1980, I fished 800-1200 traps east of Bullard Light. I would catch 150-300 pounds of legal sized lobsters and 200-300 pounds of shorts. Traps were baited with five to six shorts in each trap. After 1980, there weren't enough shorts to use. ...From 1972-1987, I averaged 12-20 pounds of lobster per trap. By 1987, I had 2400 traps."

"My best day was 2,442 pounds using 450 traps in the early 1970s, with six nights of soaking. Most days I caught 1000 -1200 pounds. From August to December 25, 1987, I caught 41,000 pounds of lobster out of 2400 traps."

"In the late 1970s, I used to get at least three to four keeper lobsters per trap off Marquesas. In 1986/1987, it was reduced down to approximately one keeper per trap."

"In 1970, I started out with 300 traps. In 1987, I had 2000 traps in order to keep up with everyone else."

"In 1988/1989, I averaged 12-20 pounds of lobster per trap on average in the middle Keys. That was the last good year. Since 1989, I now average eight to nine pounds per trap."

"In the past in the middle and upper Keys, with 300 traps I averaged 500-600 pounds of lobster. Now with 300 traps I average 200-300 pounds. In my first year of trapping with little knowledge, I averaged 25 pounds per trap by the end of the year. Overall, the pound per trap ratio has decreased. I noticed this three years ago."

"Ten years ago, I averaged a pound a trap on a four night set in Florida Bay. Now I am lucky if I get 1/2 to 3/4 pounds a trap on a week set. I used to have 1200 traps until a few years ago. Now I have 800 traps. I'm having to set longer to get less lobster. I do not want to invest the money into the traps until I have an idea of what the future will be [with Florida Bay]."

Trap Losses

Trap loss in the Florida Keys is primarily associated with water and weather conditions, the increased number of boats and traps in the water, and destruction by sea turtles. Several interviewees also said poaching had increased.

Two people said traps last longer in the ocean than Gulf, but the replacement rate is higher in the ocean due to high boat traffic. Declining water clarity in Florida Bay has also increased trap losses.

"Ocean traps last five to six years while Gulf traps in the lower Keys last three years, whether they are dipped or not."

"It used to be that trap replacement was ten percent in the Bay and 25 percent in the ocean."

"I used to set traps in the 'dead zone' area of west Florida Bay. Now I have them in the inshore waters. I switched about four years ago [1988/1989]. Normally, I have a 15-20 percent trap replacement rate at the end of the season. In the past two years due to the declining water quality [in Florida Bay], I have close to an 80 percent replacement. The increased expense and declining income, due to less catch and lower prices being paid, is causing me to go out of business."

"Now traps in the Bay only have a two year life span."

The March 1993 "Storm of the Century," which moved from southwest of the Dry Tortugas to the Florida panhandle and across to the east coast of the northeast Atlantic states, caused a lot of fishing gear to be lost. Winds at Fort Jefferson in the Dry Tortugas were clocked at 109 knots. Estimates of lobster trap losses ranged from 20-60 percent.

"Traps in the west Florida Bay area were moved to the southeast .1 to 2.5 miles. When found, they were missing concrete, were rolled and tumbled so much that most of the lids were lost, numerous slats were broken, ropes chafed, and cut themselves off. The Key West fishermen stated that a lot of their traps ended up with rounded edges and had holes punctured through the sides."

"North to northwest winds were dominant in Florida Bay and the Gulf. A lot of traps were destroyed. Two to two and a half months after the storm I started seeing lost buoys in the Gulf Stream 20 miles off Marathon. These buoys were from traps that were in the Gulf prior to the storm. I would have thought that they would have gone through the bridges. Instead, they went west along the Gulf side of the lower Keys out to Tortugas. Probably came through Rebecca Channel and up the Gulf stream. I never realized how much the current behind the lower Keys moves west and around to Tortugas. As of the end of June 1993, I was still seeing the buoys."

Lobster fishers felt that poaching was a serious problem and that it had increased in the middle and upper Keys. Some interviewees believed the population increase in south Florida and the upper Keys was to blame.

"[There is now a] 15 percent lost yield in the Bay due to poaching and approximately 25-30 percent lost yield in the inshore waters."

"The worst poachers are Florida people."

"Poaching is a big problem but it is more of a local problem. In the old days you knew the boats and their traps. Now there are so many traps that you can't tell if a person is pulling just his traps or others [because the traps] are so close together. There are a lot of 'leeches' out there now."

Some commercial lobster fishers said the increase in poaching, water quality problems, and area closures in the upper Keys, are forcing them to relocate to Key West.

Many fishers observed sea turtle damage to their traps, mainly from loggerheads. Turtles destroy the trap when they are trying to get the lobster.

"[They are] very ornery. I once had a turtle follow the trap all the way to the boat. I keep trying different construction techniques to keep them out but they will change their method of trap penetration. [The turtles are] very determined."

Bycatch and Trap Fouling

While discussing the issue of bycatch, several fishers who work in Florida Bay said they are seeing increases in octopus and hermit crabs.

"Invertebrates that are caught in traps are sold to tropical fish collectors. I'm seeing more hermit crabs and a major

> increase in octopus. Also seeing a decline in live triton trumpets in the traps."

> "In the traps I'm catching a lot more catfish, toadfish and octopus, all dirty water creatures."

Others noticed an overall decline in the "favorable" bycatch from the Bay. Favorable bycatch is the fish and invertebrates that are sold to the tropical fish wholesalers.

> "There has been a decline in the bycatch, which used to consist of a high number of decorator and calico crabs, which were sold to the tropical fish industry. Normally, we would catch 15-20 calicos in one day. Now, we catch in one month what we used to catch in one day. I think it is due to the algae bloom that was in the Gulf. The last few years we have been getting a lot of octopus in the traps. These are medium to large octopus and at times there are 200-300 pounds of them in the traps. It is a real problem."

> "Get more sea cucumbers in the traps than before. I do not get the octopus [in the nearshore waters] like the guys in the Bay or the offshore traps do."

> "Eels like to go into the traps. Also, cardinals, high hats, squirrel fish, cowfish, trunkfish, crabs and other invertebrates. Trunkfish and cowfish eat the eyes off the lobster then proceed to eat him. When placing traps between islands you get a lot of peppermint shrimp."

Lobster fishers working in Florida Bay also noticed an increase in algae that gets into and grows on their traps.

Only one person said he has not noticed a change in the type of algae, just in the method of fishing the traps.

> "[There is the] same growth on the traps now as in the past, but in the past, traps were pulled more often so that stuff did not have a chance to really foul the trap."

Two people described seeing young lobsters covered with green, hairy algae in Florida Bay and in the Seven-mile Bridge area. According to one scientist, the algae probably did not harm the young lobsters because they were molting.

> "Just this past August [1992], four miles north of Grassy Key, I saw that a lot of the short lobsters had long, green, hairy algae growing all over them, covering them."

Besides algae, many lobster fishers described a slime that they are seeing on the traps and even on some lobsters.

> "...getting an unknown slime covering the traps in the Bay. Started getting real bad the last few years."

> "Off Long Key, approximately three miles offshore, [I] caught lobsters that looked as though they were in a cocoon, a snotty slime."

Another problem, primarily experienced by the lobster fishers working in Florida Bay, is the tremendous increase in barnacles and worms that are destroying the traps.

> "The biggest change I have noticed with my traps is the increase in barnacles. The barnacles are now consuming the traps. The astronomical increase occurred in 1988, the same year all the fresh water was cut loose from C-111. In the 1970s, it used to be that if you stayed east of 'the line', you

would not have a barnacle problem in the Gulf. The line used to be off Harbor Key, now the line has moved east toward the Park at Bullard Light. ...Where you have a barnacle problem you also have a worm problem, goes hand-in-hand. Usually would get barnacles if the traps were placed in sandy bottom [barren] areas. If you put a trap on dark bottom [seagrass] areas, you did not get barnacles. As the Bay died off and became slicker, we got more barnacles. With the death of the seagrasses we have had an increase in barnacles. The sandy, barren bottom areas have multiplied. Key West lobster fishers do not have the brackish water flow and they do not have a worm or barnacle problem."

"Boring worms on the traps increased with the increase of rainfall and fresh water. Prior to 1987/1988, we had minimal worms. They got worse afterward. When there is a lot of rain the barnacles also go nuts. We get barnacles big in the nearshore waters in October and by the middle of November they are reduced. The end of April/May the barnacles pick up again. The worst area for barnacles and worms is the area near Shark River and south. Two years ago [1991] at the end of the season, I started getting barnacles bad near Long Key, on the bay side. Never had them there before."

Historically, there were always minor problems with worms and barnacles.

"We used to have a problem with worms in the old days eating the hemp rope. Always had a problem with worms in Key Largo [on the oceanside]."

"In the past when there was a lot of rain and water flow from the Everglades, we got a lot of worms, jingle shells and barnacles on the traps [placed north of Big Pine Key]."

"We used to get some barnacles but it wasn't a problem. Also, we would get a brownish film on the traps but it wasn't detrimental to the trap [off Key West]."

"Traps in the Tortugas started getting barnacles on them four years ago (1988/89)."

Other Comments On Lobster

Several scuba divers and snorkelers commented on the lobster population, and have observed a definite decline in lobster.

"In the late 1960s, two people snorkeling at Looe Key caught 400 pounds of lobster. Ten years ago [mid-1980s], could not even get 100 pounds."

Some people said they saw a decline in the number and size of lobsters at the beginning of the lobster season.

"In the late 1970s, it used to be very good to dive for lobsters up to October, in the nearshore and channel areas. Now, I'm hard pressed to find them. Too many people around now [in the middle and upper Keys]."

"I used to see lobster all along the shoreline, not now. [There has been] a definite decrease of lobster in the nearshore waters [of the middle Keys]."

"In the last six to seven years there has been a decrease in the overall size of lobsters [in the lower Keys]."

One person did say he is seeing plenty of juvenile lobsters in Card Sound, Barnes Sound, and the nearshore waters of the upper Bay.

Several negative comments were received about sport lobster season. Interviewees complained about the number of people, the use of bleach by recreational fishers, and the destruction of coral heads and hard bottom communities.

> "The lobster hunters that come to the Keys only for lobster season fill up on so much lobster that they have enough to feed themselves all year. They come to the Keys, rent a home, and go back and forth all day collecting lobsters. To hell with the limits. They would even shoot jewfish and any other fish that got in their way. Divers in the canals would clean out the lobsters a week before the season ever opened. ...Divers in residential canals are a big problem."

Stone Crab *(Menippe mercenaria)*

Stone Crab Landings		
NMFS landing data, high year	1990	2,686,916 Lbs.
NMFS landing data, low year	1973	472,500 Lbs *
Beard Everglades Document	1935	13,000 Lbs.
Dept. of Commerce Report	1919	22,000 Lbs
*Landings of stone crab significantly increased between 1976 and 1977.		

Stone crab season is October 15 to May 15. Only the claws are taken, and the crab is thrown back into the water alive. Stone crabs have been sold in the Florida Keys, wholesale and retail, for more than 30 years. In the Keys, approximately 200 local fishers harvest the crabs between Marathon and Chokoloskee, on the northwest edge of the Everglades.

Historically, stone crabs have been enjoyed by native Floridians since the days of the Glades Indians. Early settlers considered stone crabs to be a valuable food staple. The stone crab fishery did not become a booming industry until the mid-1960s when markets were established in some of the larger cities in the United States. Before 1965, most stone crab claws were only marketed in the Keys and Miami.

According to the 1923 Department of Commerce Report, stone crabs were caught throughout the year in the 1920s.

> "...but the most favorable fishing obtains during February, March, and April. They are found rather near the shore and generally not farther than one mile from land. Very few fishermen specialize in catching crabs, and most of those caught are taken incidentally with crawfish."

The stone crab harvest has remained largely constant in recent years. A larger market that targets international countries has been created. With the increase in demand, more traps are being placed in the water.

Stone crab fishers who move their traps around have not observed a difference in their catches. Fishers who do not move their traps have seen a decline, which they attribute to ecosystem changes especially in Florida Bay.

> "I do not see a difference in my catch, but I am having to move traps further and further away. I used to crab 20-30 miles offshore [in west Florida Bay] up until 1986. Now I have to run between 40-60 miles offshore to place traps."

A few fishers from the lower Keys said they have seen a decline in the stone crab population in Sugarloaf Sound.

> "I used to see a lot of stone crabs and blue crabs in Sugarloaf Sound. It has been declining. Now I do not see as many. The difference is that the surrounding area has become much more developed. [There is] a lot of muck on the bottom now."

> "I have been setting stone crab traps in Sugarloaf Sound [for years]. In the Sound I had a 70 percent decrease in catch during the 1992/93 season. There were also more males this year."

Blue Crab *(Callinectes spp.)*

Blue Crab Landings		
NMFS landing data, high year	1990	20,168 Lbs.
NMFS landing data, low year	1987	1,423 Lbs.
Beard Everglades Document	1935	Information not available
Dept. of Commerce Report	1918	Information not available

Several trap fishers said stone crab traps placed off the 10,000 Islands area (north of Cape Sable) have recently been catching blue crabs. These fishers must now place their traps in deeper water to catch stone crabs. They believe the increase in the blue crab catch off the southwest Florida coast coincided with the increase in freshwater flow from the Shark River.

> "The year they dumped all the fresh water into the Bay [through Shark River] is the same year that blue crab catches rose. Like a gold rush, never before has there been such a catch off of Shark River and [the area from] Northwest Cape to Middle Cape. It's unheard of. At the same time, the stone crab have been run offshore. Where the fishermen used to catch stone crabs, they are now catching blue crabs in those traps. No more stone crabs nearshore."

In Monroe County, many blue crabs are caught near the shoreline of mainland Florida. One person said he saw more blue crabs, especially big blue crabs, in Card Sound since Hurricane Andrew hit south Florida.

> "Years ago you had to go way back into the estuary (wetlands) to get them."

Another person said there once were many blue crabs in Blackwater Sound. Other people commented that blue crabs could be caught in some of the "impoundment" areas in the Keys, such as ditches and interior mangrove areas. The catch is dependent on rainfall.

Shrimp and the Shrimp Fishery

Food Shrimp *(Penaeus duroarum)*

Shrimp Landings		
NMFS landing data, low year	1991	3,267,315 Lbs
NMFS landing data, high year	1981	15,733,173 Lbs
Beard Everglades Document	1935	Information not available
Dept. of Commerce Report	1918	Information not available

Commercial shrimping became a major industry in the Keys when pink shrimp beds off the Dry Tortugas were discovered in the late 1940s. Before this, fishers from the Carolinas and Texas dragged their nets

during the day, and tried unsuccessfully to make a living as commercial shrimpers in the Keys. Not until a few boats dragged their nets at night did the "pink gold rush" begin.

There are two main commercial shrimp markets: brown shrimp and pink shrimp. They are vastly different. Brown shrimp are caught during the day, while pink shrimp are caught at night (they burrow into the mud during the day).

> "...the shrimping in the Keys is unique, the bycatch and the turtle catches are different, not just because of the day/night factor but also because in the Keys shrimping does not start until 20 miles offshore, where in other areas like north Florida, the shrimping is done closer to shore."

There are two types of shrimpers, those who shrimp the Tortugas year-round, and those who fish off the Alabama and Texas coasts in the summer, but return to the Tortugas for the rest of the year.

> "...the start of the big shrimping boom in the Keys was from 1948 to 1950. Thousands of boats from Texas to the Carolinas would come down here during the winter months, then go back home, following the shrimp run in their areas."

Until the 1980s, most of the Tortugas fleet -- more than 300 boats -- worked out of Key West. Now only a few boats remain.

As of 1965, there were approximately 27 shrimp boats working out of the Marathon area. The Marathon fleet grew, according to some, because it "was a small commercial fishing community made up of families, while Key West was a bit wild." Fewer boats made it easier to unload shrimp in Marathon. In Key West, shrimpers waited in line to unload. "Headers," people who deheaded shrimp, were also easier to get in Marathon. The last Marathon shrimp boat was sold in 1992.

According to one commercial shrimper, a tag and release study by Dr. Milton J. Limbner in the late 1950s or early 1960s showed that shrimp tagged in Cape Romano and north of Marco Island showed a mixed return, with 50 percent of the shrimp recaught in the Tortugas and 50 percent recaught off Sanibel Island. Shrimp tagged from Flamingo to Cape Romano had a 100 percent recovery rate in the Tortugas.

According to several people, the shrimping area runs north, northwest of Smith Shoals (northwest of Key West), in 78-80 feet of water just past the loggerhead sponge area, out to the Tortugas to about 120 feet of water. Shrimpers, other than bait shrimpers, never fished Florida Bay. The target shrimping area has remained roughly the same for the past 40 years.

Several interviewees said the most productive shrimping areas "moved" to the west. Until 1985, the shrimping grounds (eastern area) started at Smith Shoals, but it now begins north of New Grounds to the west of Smith Shoals. The eastern area has now become less productive.

For many years, shrimpers had constant catches of seven to eight million pounds of shrimp per year. Now the annual catch averages between three and four million pounds. Statistics show 1981 (see Monroe County Commercial Landings chart, Table 3) as the highest catch year, but one interviewee felt that the best shrimping time was October 1960, after Hurricane Donna.

> "Normally there is a three to four foot tide range in the 'glades. After Donna, there was no real tide, the water just flowed out of the bay for ten days to

> two weeks. During that time, we caught the most abundant amount of shrimp at once."

One interviewee claimed that, after the 1981 peak, catches declined because of the 1982 shrimping regulations, not because of a decrease in shrimp. This person also felt that the shrimp catch dwindled from pollution and not overfishing. Another person voiced the same opinion:

> "...the change in shrimping really came about due to regulations and pollution."

According to both individuals, many shrimp boats were sold after 1982. The regulations designated closed areas, primarily nursery areas. Several people said there was no real enforcement of the closed shrimping areas designated by the Gulf Council.

One commercial shrimper and fishery spokesperson said the shrimp catch was fairly stable from the 1950s to the early 1980s. In 1980, shrimp imports made up 49 percent of the U.S. market, while domestic shrimp made up 51 percent. In 1993, shrimp imports made up 78 percent, while the domestic market made up only 22 percent. The retail price for shrimp has stayed almost the same since 1983.

A report about the Tortugas pink shrimp industry, written by James Nance of the National Marine Fishery Service and presented to the Gulf Council in July 1992, stated:

> "...during biological year 1986 (July 1986 to June 1987), a 40 percent decrease from the average was observed on the Tortugas grounds. Although an increase in catch from the Tortugas grounds was noted in biological year 1987, the last two fishing seasons have produced very poor pink shrimp yield. Biological year 1989 produced the worst yield of Tortugas pink shrimp since current records began in 1960. A slight increase in catch from 1989 to 1990 was noted."

This report goes on to say that, from 1960 to 1985, the catch per unit effort averaged 598.23 pounds per day (± 80.59 pounds per day). During the last four years, the catch per unit effort has been approximately 418, 459, 417, and 390 pounds per day.

> "Yield per recruit was enhanced with the presence of the Tortugas Sanctuary, since it prevents fishing on small shrimp as they migrate from the nursery areas to the offshore fishing grounds. Yet, overall yield is determined from number of recruits entering into the fishery each year. Low periods have been experienced throughout the 30-year history of the fishery. Yet, the lowest points ever experienced occurred during the biological years 1988 and 1989. Spring recruitment (January to June) has experienced little noticed change during the 30-year period, while a decreasing trend is visible for fall recruitment (July to December)."

Many shrimpers felt it would be difficult to overfish the Tortugas shrimping grounds because there are many natural formations that shrimpers cannot work. Shrimpers drag in muddy bottom and must avoid wrecks and hard bottom areas because they tear up nets. Grass beds clog nets and are also avoided.

Shrimpers noticed a significantly lower catch in 1977/1978, an extremely dry year. Heavy rains seem to have an important effect on catch.

> "...anytime you had a heavy rain in the 'glades or in Miami, or a tropical depression with a lot of rain and wind came through south Florida, within ten

> days to two weeks afterward there would be a run of the small shrimp from the Bay to Tortugas."

The "Storm of the Century" in March 1993 created excellent shrimping conditions until the full moon days later. Heavy rains in south Florida apparently made the water too fresh in Florida Bay, and the shrimp ran to the west.

Most shrimpers associate shrimp declines with problems plaguing Florida Bay.

> "...shrimpers have been yelling for 15-20 years now about the freshwater diversion in the Everglades."

> "...on calm nights when going out early in the morning out into the Gulf, I used to see the shrimp in the Bay popping at the surface, not any more."

> "...shrimp are the canaries in the coal mine for Florida Bay."

According to the July/August 1993 Gulf Council Newsletter:

> "The Tortugas shrimp fishery remains below its historic production levels at slightly above 50 percent of its historic level prior to 1985. The cause of the decline is believed to be environmentally related to the die-off of the grass beds in the area [Florida Bay]. Recruitment remains low but has increased slightly in 1991."

Shrimpers also discussed bycatch. One interviewee said that bycatch is not a problem:

> "Dragging at night you do not get many edible fish. What is caught is saved and sold to the charter boat captains and commercial fishers for bait and chum."

> "If you catch grouper, you know you are in the wrong bottom."

Another person said that, in 18 years of shrimping the Tortugas, he has caught only one green turtle, which escaped from the net.

Others made observations concerning bycatch. One person who worked on a shrimp boat in the 1950s said if the nets were pulled too close to dawn, they would get fish as a bycatch. Otherwise, pulling the nets at night yielded few "trash" fish. Another person who was "hitching a ride to the Tortugas" on a shrimp boat observed pinfish, pilchards, small mangrove snappers, blue crabs, and stone crabs in the shrimp trawl.

Most shrimpers said they never had a problem with algae in their nets. Seagrass clogged their nets if they got too close to the grass beds. Shrimpers often have had trouble with moon jellyfish (*Aurelia*) clogging nets. They occasionally have had problems with another jellyfish they described as "large, slimy, with long tentacles and a strong odor."

One person observed a change in an area called the "smokehouse" near Smith Shoals. In 1987, scallops moved into the area and the shrimp moved out. In 1992, the shrimp returned to that area, which has a soft, fine, mud bottom.

Some shrimping is done in bay areas, primarily near Jewfish Creek, by "recreational" shrimpers working the run of shrimp through the creek. One interviewee said it was once popular to catch shrimp with a hand net off the Navy docks in Key West. The shrimp came in all sizes and were large enough to eat. This same person thought shrimp could still be caught off the dock. Another long-time Key West resident said there were once

large shrimp in the drainage ditches in Key West, before fill was brought in.

BAIT SHRIMP

Besides the food shrimp market, there is also a live bait shrimp market in the Keys. Bait shrimping is seasonal. No shrimp are available in summer, but scouting begins in late summer to October. Shrimpers go where the best quality and greatest number of shrimp are found. This year (1992/93), one interviewee said that his best catches were out of Card and Barnes Sounds. He thought this was due to Hurricane Andrew and all the autumn rain. He said he had good catches when "freshwater chases them out [of the wetlands]." Last year (1991/92), this person had good shrimp catches off Lower Matecumbe Key near the location of the algal bloom in Florida Bay. He also had a great year shrimping in Manatee Bay/Barnes Sound when the Aerojet canal (C-111) plug was pulled (1988). Manatee Bay, he said, is no longer a good shrimping area.

The areas that are shrimped today are not the areas that the "old-timers" shrimped. In the "old days," Barnes and Little Buttonwood Sounds provided the most plentiful bait shrimp. One person was told that the old-time bait shrimpers caught lots of bait shrimp in Tarpon Basin (bay side of Key Largo). That area is now described as "just a mud hole." Bait shrimpers also once used Blackwater Sound, but not now.

Bait shrimpers use a roller over shallow, hard, sandy bottom and seagrass areas. One interviewee said that in the 1930s, south of the Rickenbacker Causeway in Biscayne Bay, the bay was clean (barren) with just a few, short-spined urchins. Years later, when the bait shrimpers started shrimping Biscayne Bay, this person saw lush seagrass starting to grow. The only difference he observed was that the bait shrimpers had started working the area. A few bait shrimpers claimed that the roller helps to keep seagrass beds clean, and compared it to aerating a lawn.

Bait shrimpers were asked if they had noticed changes in their bycatch or the items coming up in their nets. One person said he was getting more "roller" sponges (sponges he claimed had been previously broken off their holdfast by some other activity) and "rolling moss" (algae) in his nets. Also, more medium-width, dead seagrass was coming up in the nets. The bait shrimpers stressed that they do not waste their bycatch. Other species are either returned live into the water or sold. Apparently, they once caught many small fish including spiny box, cowfish, seahorses, and sting rays in their nets, which were sold live to tropical fish collectors. The shrimpers reported recent declines in these species.

Other Crustaceans

LARGE CLAW SNAPPING SHRIMP
(Synalpheus spp.)

One person said he does not see as many snapping shrimp in the shallow waters of Florida Bay as in years past.

CALICO CRAB AND DECORATOR CRABS, VARIOUS SPECIES

Several people noted a decline in the population of both calico and decorator crabs in western Florida Bay. One person thought the increase in macroalgae was smothering the homes of these species. Another person reported an increase in decorator crabs in 1992, on the bayside of Lower Matecumbe Key in the nearshore shallow waters.

FIDDLER CRAB *(Uca spp.)*

One person who grew up in the Homestead/upper Keys area said that fiddler crabs and other small crabs have virtually disappeared from south Florida, including Everglades National Park and Florida Bay.

> "These little creatures were very abundant 30 or more years ago, particularly in areas along the shoreline where there was marl formation. The habitat in the Park has not changed, although it might be argued that the habitat and the areas outside of the park have changed."

This person was not sure why crabs declined, but felt their disappearance played a role in the greater changes observed in Florida Bay.

OTHER INVERTEBRATES

During the interview, each person was handed an invertebrate species list and asked to comment on changes s/he had observed regarding any of the listed species. The list in its entirety can be found in Appendix A.

Jellyfish, Anemones, and False Corals

Several people noticed a general increase in jellyfish everywhere. One person said jellyfish were particularly abundant off Sawyer Key (north of Upper Sugarloaf Key) two winters ago (c. 1991).

Several people mentioned "sea lice," also called "bathers itch." They first noticed it three or four years ago (1988 or 1989), but never dealt with it before then.

In an issue of *Sea Frontiers* (July/August 1993), Dr. Alina Szmant described the history and cause of sea lice outbreaks.

> "The correct name is 'sea bather's eruption.' ...An outbreak of what may have been sea bather's eruption was first reported in Florida in 1903; other occurrences were noted in the 1930s and 1940s. After an apparent hiatus of more than 20 years, sea bather's eruption reappeared in Florida in the 1980s. ...the source of sea bather's eruption is the larvae of the sea thimble *(Linuche unguiculata)* [a jellyfish]. ...It spawns in spring. ...1992 [was] a banner year for sea bather's eruption."

MOON JELLYFISH *(Aurelia aurita)*

Many interviewees said they saw an increase in moon jellyfish since the mid-1980s. A few associated this with the increase of algae in the water. After Hurricane Andrew, one person saw more moon jellyfish in the shallow waters of Carysfort Reef than ever before, "...[there was] one jellyfish per square meter as far as the eye could see."

Another person saw a "tremendous amount" of moon jellyfish in Florida Bay and Boot Key Harbor in 1992/1993. "Where they are you don't catch fish." This person also felt the increase in jellyfish was associated with an increase in nutrients in the waters.

CANNONBALL JELLYFISH *(Stomolophus meleagris)*

Interviewees from Marathon to Key West have noted cannonball jellyfish only the past few years, especially the winter of 1992 to 1993. These jellyfish were seen

from Key West harbor to the reef tract and from the Marathon shoreline out to the Gulf Stream.

UPSIDE-DOWN JELLYFISH *(Cassiopea spp.)*

Upside-down jellyfish are seen mostly in canals and nearshore waters. Most people associated them with stagnant waters and developed areas. One person said that upside-down jellyfish disappeared from the canals in Key Largo approximately eight years ago [1985], during a building moratorium in the upper Keys.

> "When building started up in the area again, the *Cassiopeas* came back strong."

This person felt *(Cassiopea)* increased as a result of pollution and sewage. Another person said, "In a good-flushing canal you will not get *Cassiopeas*."

GIANT ANEMONES *(Condylactis gigantea)*

A few people said there are fewer giant anemones (pink-tipped anemones).

> "All of a sudden they disappeared two to three years ago. I don't know if it was from over-collecting -- they were collected pretty hard -- or from disease, or from nature."

> "If you heavily collect the anemones from one area, you will wipe out that area."

Another person observed bleaching of pink-tipped anemones the last two years. This person felt it was due to warm water inversions. He also saw a die-off of "Curly Q" anemones in Florida Bay near the algae bloom. Rock anemones also bleached, but did not die. He believed the anemones were coming back.

RICORDIA *(Ricordia florida)*

One person said there was a lot of *Ricordia* on top of Looe Key in 1983. Since then, its numbers have decreased on the forereef at Looe Key. In 1985 or 1986, he noticed that *Ricordia* had moved from the direct flow of water moving over Looe Key and into the crevices. A few people said there are *Ricordia* in Hawk Channel and on some offshore patch reefs in the lower Keys.

IVORY BUSH CORAL *(Oculina spp.)*

One interviewee said *Oculina* is found in deep reef areas, usually surrounded by pigmy angelfish. It is found from Big Pine to Marathon, especially in Bahia Honda Channel. Another person said *Oculina* is found in areas with strong currents. He also said that in some areas, macroalgae are "pushing out" the *Oculina*.

Mollusks

One person noticed a decline in mollusk egg cases and juvenile shells. He felt they were being collected, especially by tourists, in significant numbers.

Another interviewee said he has noticed an increase in limpets, especially in the lower Keys.

QUEEN CONCH *(Strombus gigas)*

The queen conch was an important commercial species in the Keys until it was over-collected for its food and shell. In 1985, the queen conch was declared a protected species and harvest is now illegal.

A Department of Commerce Report (1923) said:

> "...conchs are plentiful enough to supply the present demand, but the supply could easily be depleted by overfishing."

According to many long-time residents, conch were more plentiful in the 1940s/1950s. Several people said there were so many conch then that they would frequently step on them in shallow waters near shore. Most also said the population is now "looking good again." Some people said they never believed there was a problem with the conch population.

People reported seeing more conch in the seagrass areas off Key West and along the reef tract throughout the Keys.

> "I see more conch on the reef now than in the inshore waters due to better water conditions on the reef."

One person said there were still many juvenile conchs, but hardly any large conchs on the oceanside, nearshore flats near the west end of Lower Matecumbe Key.

Scallops

A few people said there was a scallop boom in Florida Bay near Barnes Key (north of Lower Matecumbe Key) in the late 1960s. The scallops stayed for about two years, then vanished. Another person said scallops have appeared twice in that area of the Bay. There was also a stable population of scallops in the basin between Rabbit and Man-of-War Keys in the 1950s.

Clams

Most interviewees had little to say about clams. One person said there was a big clam bed off Shark River in the 1950s. He described the clams as being "big quahog clams."

A Department of Commerce Report (1923) on the clam industry in Florida Bay stated:

> "What is probably the largest bed of hard clams in the United States is found off the southwestern coast of Florida, in the region of the 10,000 Islands (between Gullivan's Bay and Shark Point). ... Fresh water supplied in part by the numerous small rivers of the 10,000 islands lowers the density of the water on the clam bar, particularly during the rainy season. This brackish condition of the water is especially suitable for the growth of the clams. ...Eelgrass thrives in nearly all places where the clams are abundant. ...In most places where this grass is absent, few or no clams are present. ...The clam beds of Southern Florida can bear considerably more fishing. The large clam beds of the 10,000 islands are practically virgin and await development."

This clam bed no longer exists. The date of its disappearance is unknown.

Horseshoe Crab *(Limulus polyphemus)*

One interviewee observed an increase in the deaths of horseshoe crabs in Blackwater Sound in the last two years. In May 1993, he saw 15 dead horseshoe crabs washed into the canal system on the bayside of Key Largo.

Copepods, Isopods, and Amphipods

Some people said they once saw parasitic copepods only on Chromis fish. Now they

see them on other tropical fish throughout the Keys.

People have also noted more parasitic isopods on mangrove snappers, grunts, and most recently, dolphin (mahi-mahi).

Amphipods are small but plentiful benthic organisms. According to two interviewees (both scientists) there are at least 180 different species of amphipods endemic to the Keys. They are ecologically important and have demonstrated a sensitivity to pollutants and toxicity. One scientist said amphipods were doing well. Amphipods are a primary food source for juvenile organisms, and are very sensitive to change. He said if amphipods are absent from an area, something is wrong.

Sea Stars, Urchins, and Basket Stars

Sea Stars

Several people said sea stars have disappeared from the reef area. "They used to be everywhere." One interviewee had not seen a live, common starfish on the oceanside in ten years.

One person, a scientist, noted the disappearance of small sea stars (*Echinaster sp.*) in the nearshore waters off Long Key where they were once abundant. Instead, this person saw more of the big stars (*Oreaster sp.*), which were uncommon in the past. He thought siltation might be a cause.

Long Spined Sea Urchin
(Diadema antillarum)

Several people gave historical information about the *Diadema* population in the Keys. One person did not remember seeing large numbers of *Diadema* in the 1920s/1930s. In the 1950s/1960s, he remembers many *Diadema*.

> "They were so plentiful it was common to break open a sea urchin to attract fish on the reef. Lots of big fish would come over to eat [when an urchin was opened]."

He said the *Diadema* population started to decrease in the 1970s, although, he added, "it is hard to say what the normal population level is."

All interviewees knew about the large, rapid *Diadema* die-off that occurred in the summer of 1983. According to several people, the disappearance of *Diadema* had a big impact on the reef; there is "more algae now covering the reef areas." One person said *Diadema* populations in the back reef (shoreward side of the reef) did not decline as severely as in the fore reef (seaward side of the reef). He also said populations of gastropods (snails) increased on the reef after the *Diadema* die-off.

One person observed that once all the urchins disappeared from a reef area, other conditions in that area declined. In fact, several interviewees described a direct correlation between the *Diadema* die-off and the decline of the reef.

There were many different opinions regarding the present condition of the *Diadema* population. Several people said they did not see them anymore. Others voiced a different opinion:

> *"...[Diadema]* seem to be coming back the past two years."

> "...this year [1993], I have seen a significant increase in the population in the nearshore waters [off Long Key]."

Some people said Diadema started to come back, but that another die-off oc curred in 1991. One area specifically mentioned was Vestal Shoals, west of Key West.

PENCIL URCHIN *(Eucidaris tribuloides)*

One interviewee, a scientist, said he did not collect as many pencil urchins in the near-shore waters off Long Key in 1993 as in previous years.

BASKET STARS

One person noticed a disappearance of basket stars (crinoids) on the reef in the lower Keys in 1983/1984. These animals are generally seen only by night divers.

> "I used to be able to see a dozen when diving."

Another interviewee said he never saw them much in the lower Keys, but sees them on the reef in the Tortugas.

Another person said he could sometimes find 50-60 crinoids off the middle and upper Keys. He believed crinoids were even more common in the lower Keys and off Key West than in the middle and upper Keys.

PART III: HABITATS

SEAGRASSES

Interviewees were asked if they noticed an increase or decrease in seagrass in their fishing/diving area, and if they saw areas that were once sand/mud become vegetated (and vice versa). They also were asked if they had detected a difference in the seagrass community, and whether they had seen an increase or decrease in organisms attached to the grasses, sediment on the leaves, and fish and/or crustaceans living in and among the seagrass.

A few people said the increase and decrease of seagrass beds were cyclic and seemed to correlate to geographic area. There were mixed reactions regarding the sand areas associated with the seagrass systems. People described fewer sandy areas (more seagrass and hard bottom) in the lower Keys, and more sandy areas (less seagrass and hard bottom) in the middle and upper Keys.

In the lower Keys, people said there was an "overall increase in seagrasses, more now than ever in the backcountry area." Several fishers, referring to bonefish areas, complained they were "losing the white spots."

> "Areas that were once beautiful, white, shiny sand areas are now either brown and 'mucky,' have turned into a 'multi-mixed' bottom, or have become turtle grass."

Another person said the seagrass beds are not denser, but they are expanding. One person said that Pine Channel (west side of Big Pine Key) was mostly white, sandy bottom with rock holes and ledges in the 1960s/1970s. He said that seagrass was now taking over the area. Yet another person said Bahia Honda once had hard bottom with holes where snapper and grouper abounded. Now sand and grass have filled the holes.

One interviewee saw a general decrease in seagrass beds in the lower Keys. Another person, a long-time resident, said the area around the Content Keys (north of Big Torch Key) was once laden with seagrass, but now consists of sand. One interviewee said he really started seeing large areas of seagrass dieoff near Johnson Key and East Bahia Honda in 1985.

In the middle and upper Keys, one person saw a decrease in seagrass bed. Another person said the banks off Islamorada (oceanside) have shallowed where the turtle grass is growing and expanding. He observed that the seagrass areas have expanded tremendously from the reef to the shoreline.

> "After 1935, at least a mile and a half of linear area was pure, white sand. Now, only a quarter of that area is sand. Since the 1960s when [Hurricane] Donna went through, most of that white sand area has become seagrass."

One interviewee, a scientist who has researched seagrass extensively, said in several areas throughout the Keys, bank tops of the seagrass beds have "burned off" due to exposure at low tide. His comment corroborated many statements that several seagrass and bank areas have been getting shallower and increasing in size, especially near Indian Key and Tea Table.

Many people saw increased sediments on the seagrass beds and in the nearshore

water areas. They said the seagrass "used to be very clean with not many epiphytes." Several people said there were now more fine sediments (which are easily resuspended into the water column) in the seagrass beds. One interviewee said that, in front of Sawyer Key (north of Cudjoe Key), the seagrass areas have "disgusting looking growth" (epiphytes) on them. This person also noticed that where seagrass once grew, there is now yellow, bushy algae.

In the upper Keys, one interviewee noticed a white fungus growing on the seagrass beds in Card Sound in 1992. This person observed that some seagrass beds, which had been worked by a bait shrimper, were healthier than an unworked bed in the same area. He attributed this to the method and equipment of the bait shrimper.

> "A cleaner seagrass bed has more young snapper and baby trout in it than a dense, heavily covered bed."

Another person saw a total decline and change in an area due to shrimping. According to him, in the 1950s, in Hawk Channel off Marathon:

> "...the shrimpers came through dragging their nets and scraped up the grass. Afterward, there was no grass, no bait, no shrimp. The area turned to mud."

Interviewees were asked if they had seen prop scars in seagrass beds, if there was an increase or decrease in the prop scars, and the locations of badly scarred areas. Most noticed an increase in prop scars in the seagrass areas throughout the Keys, and voiced the need for more channel markers. With more non-residential boats on the waters of the Florida Keys, they felt channel marking was a necessity.

> "When the Fish and Wildlife Service had the Coast Guard remove the markers in Bogie Channel [east side of Big Pine Key], it caused an increase in accidental grounding and prop dredging due to the lack of water knowledge by the novice boaters."

Most people agreed that prop scars have increased in direct proportion to the number of boats on the water. One local scientist estimated that five to ten percent of all seagrass beds in the Keys have suffered severe damage from prop dredging. Prop dredging causes the chronic resuspension of sediments into the water column. Waves from boats further impact an already disturbed area.

According to interviewees, heavily impacted areas include an area within Pennekamp State Park, Holiday Isle (oceanside, Islamorada), Jack Bank (north of Bahia Honda), Port Pine Channel (northwest side of Big Pine Key), Content Keys (north of Big Pine Key), Sawyer Key (north of Cudjoe Key), Snipe, Barracuda, and Mud Keys (all north of the Saddlebunch Keys), and Jewfish Basin (north of Boca Chica).

One person said self-made channels created by boat props were getting larger. This person claimed that some of these artificial channels have changed currents in the surrounding areas.

FLORIDA BAY

Historically, Florida Bay was a mosaic of seagrass species that existed in an estuarine community. A few scientists said that *Halodule* was once the dominant grass in Florida Bay.

> "According to information that I received, mud and *Halodule* bottom

were replaced by turtle grass. Muddy sparse *Halodule* beds that were present in the northeast Florida Bay area in the 1960s had been replaced by turtle grass beds by 1979. It was normal [within the Park area of Florida Bay] to have less dense seagrass areas. The movement of turtle grass into the Bay probably occurred in a 20-40 year span. A study of plant succession shows very gradual processes and changes. Dominant vegetation in Florida Bay is now turtle grass and *Laurencia* [a bush, pink or yellow alga]. Florida Bay is now a monoculture."

One scientist said there was a progressive community change in the seagrass since 1987. One person said his father talked about the "huge drifts of grass" that he saw (circa 1935) north of Bullard Light, west of Sand Key and south of Cape Sable (west Florida Bay area). He described the grass in the "drifts" as having skinny blades, possibly *Halodule*.

One interviewee, a commercial fisher who worked within the Park area, offered the following historical information:

> "[In the 1940s and 1950s] northeast Florida Bay used to be muddy all the time, a pale white muddy clay. There was no real vegetation. Now you don't have the mud as before. "Wiregrass," [a dark brown bramble], has taken over. The last 25 years, the wiregrass has really grown strong."

Another person said:

> "The east part of Florida Bay used to be made up of three kinds of grasses, not anymore. *Halodule* used to be very thick until the late 1970s. *Ruppia* was intermixed. [The Bay and the seagrass locations] were more affected by the tide [in the past]. Calcareous algae, *Halimeda*, used to be in large patches in the Bay. ...It went down the tubes real quick. The drastic change started to occur in 1985."

There are two main areas of seagrass die-off in Florida Bay, one within the Park boundaries, and another just west of the Park boundary, west of Sandy Key. Commercial fishers call the area west of Sandy Key the "dead zone." In 1979, scientists mapped a seagrass system in this area. The commercial fishers slowly watched seagrass die in the dead zone as water clarity declined and algal blooms became a common occurrence.

> "I first observed major seagrass die-off the summer of 1987 at Cross Bank and Rankin Lake."

Other interviewees observed seagrass die-offs along the Park boundaries.

> "In 1988 and 1989, the slough between Sprigger [Bank] and Harbor Key was a good lobster catch area. Now [1993] the seagrass is gone in that area. In 1990, I noticed the seagrass was having problems. [Looking at the seagrass beds in that area] was like looking at a spider web covered in dust... gummy looking, smelled of rotten eggs, sulfur."

> "Sandy Key used to be a picnic/recreation area for families because it had nice flats and seagrass areas with jewfish, trout, and redfish. Sprigger Bank was a nursery area for shrimp and lobsters."

One person said that last year (1992), where water came from Florida Bay to the ocean, the seagrass beds looked cleaner because many epiphytes were gone and the sand base looked cleaner.

Another interviewee observed several grass beds "recover" in some nearshore and Bay areas. As an example, he cited Card Sound and southwest Blackwater Sound where the area went from a mud bottom to seagrass.

Other interviewees also observed areas where seagrasses had died off, then came back and vice versa.

> "I have seen areas where grass beds have died off then come back again in the nearshore and Bay areas. The areas of Card Sound and southwest Blackwater Sound used to be pure mud, now those areas are seagrass. Tarpon Basin used to be a grass area, now it is a slimy muddy area like a sewer hole. This happened six years ago. ...I am seeing turtle grass areas change to thin, skinny seagrass areas in the upper [Florida] Bay."

> "I remember reading an article in the *Keynoter* newspaper within the last few years, about a scientist that said that there was a big seagrass die-off in Buttonwood Sound. I had to laugh. Buttonwood Sound is the same now as it was in 1941."

Other people added information about seagrass areas in Florida Bay:

> "Not as much turtle grass in the Bay now. There are more bare areas. From Ninemile Bank to Man-of-War Key, the grass beds used to have lots of small, little brown clams."

> "In the southeast side of Rabbit Key, between Rabbit and Arsnicker Key, there is no more water. The area has gotten shallower. In the late 1980s, there used to be a lot of hermit crabs in that area, which was a thick seagrass area."

> "In the beginning of 1993, I saw a lot more floating dead seagrass in the Bay."

> "A lot more seagrass is washing up on the Bay side of Grassy Key. It is becoming a problem with the dolphin pens. We always had some grass washing up, but the big difference now, besides the quantity, is that it smells rotten, like old grass that had already started to decay. Before, the grass that washed up was fresher."

MANGROVES

Interviewees were asked if they had noticed a general increase or decrease in mangrove areas, and if they knew of any specific mangrove areas that had died off.

Most interviewees said mangrove areas were increasing. They especially pointed out that many shallow areas have been taken over by mangrove seedlings. One person said the shoreline behind the east end of Lower Matecumbe Key has gradually extended waterward since the 1960s, and the adjacent bank is shallowing in.

Some interviewees identified problems and areas where mangroves have been impacted. In areas of high boat traffic, several people noticed channels that have become wider and mangrove trees have been felled by boat wakes. One person gave as an example the Bay Keys (north of Key West), where the channel was once seven feet wide and is now almost 35 feet wide. The difference in width stems from the destruction of the mangrove trees due to erosion.

Another person observed that, in the backcountry area north of Key West, the growth of mangroves has been declining

gradually since 1976. Also, the shoaling in (accretion) of the shallow area next to the mangroves along the shoreline has been decreasing. Until 1976, this person had seen a consistent growth and accretion rate. By 1989, the mangroves and the adjacent shallow areas stopped growing, and erosion from boat wakes became more obvious. Problem areas cited were the cuts between Woman Key, Boca Grande, and Ballast Key (all west of Key West), and Mud Key, the Snipe Keys, Lower Harbor Key, and the Bay Keys (all north and northeast of Key West). According to this person, the erosion was obvious when she took underwater photos in the mangroves.

A few people witnessed a major change in the mangrove areas of some islands within the Florida Bay area of Everglades National Park. They observed a die-off of black and white mangroves, which are found in the interiors of islands.

> "The interiors of the islands in the past were not dying off, now the interiors are dying."

> "The mangroves growing behind the reds are not as big as they used to be or should be. They seem stunted."

Along with the interior mangrove die-off, people saw a decrease in the wildlife on these islands. One person said he used to see alligators and crawfish in the mangroves. Most of his observations were made near the area where Taylor Slough empties into Madeira Bay, and at Dump and Buoy Keys.

Interviewees from the lower Keys made many comments about the die-off of mangrove trees on the two "Monkey Islands." These islands, Loggerhead Key and Raccoon Key, are located south and north respectively of Cudjoe Key and are used to raise Rhesus monkeys for research. The monkeys, most of which ran wild on the islands for years, stripped the leaves off the mangrove trees, primarily the black mangroves.

Most observations on the death or destruction of mangrove trees were associated with major storm or weather events. Hurricane Andrew, whose eye went over Homestead and then tracked westward in August of 1992, killed a swath of mangroves across the Everglades. In the winter of 1989/90, a big freeze in south Florida killed many mangroves in northeast Florida Bay that already were stressed due to dry weather conditions. In September 1960, Hurricane Donna, whose eye went over Long Key, wiped out the tall mangroves next to Shark River, the mangroves near Flamingo, and the mangroves in the middle Keys. The 1935 Labor Day Hurricane, whose eye went over Islamorada, wiped out all the mangroves in the middle Keys.

Daniel Beard's 1938 report on Everglades National Park commented on the 1935 hurricane and its impact on the mangrove forests.

> "The mangrove forests have also been badly damaged by the hurricanes. Beyond Northwest Cape where the giant mangroves started, the trees are dead northward to the vicinity of Shark Point. There was an extensive black mangrove forest near East Cape canal. Possibly, it was the finest example of black mangroves in the United States. Now there is nothing left but dead trees. The loss of this forest is, however, only partly attributable to the hurricane, for it is believed that drainage or some other activity started the decline... [for other trees around the area] except for the black mangrove area just mentioned, were not all killed. Those still living were pruned by the wind."

PART IV: WATER QUALITY

INTRODUCTION

Water quality is an especially complex subject in the Keys and Florida Bay. Salinities, nutrient levels, suspended sediment, and algae in the water are but examples of the many factors contributing to water quality. These factors vary widely in our region, even under "natural" conditions, but humans are shaping these factors, as well. That water quality, particularly water clarity, has changed for the worse is a strong consensus among those interviewed. There is less agreement on the principle causes for these changes and what should be done in response.

Most people agreed that water quality declined drastically from the late 1970s to mid 1980s. For most of the 1970s, they say, the water was consistently clear. According to some fishers, the decline in water clarity began in the Florida Bay area and in the middle Keys.

Almost everyone said they have seen an increase in particulate matter in the water column throughout the Keys. Also, there has been a definite change in the water color from "gin clear" and different shades of blue, to shades of green.

> "The waters used to be gin clear 20 years ago. The green water has moved out the channels and into the ocean. Even the reef is having problems. I used to be able to throw the Miami Herald in the water and read the print on it when it settled to the bottom. Now you can't even find the paper."

Several interviewees said that causes of water quality problems in near shore and off shore areas are separate, and warrant separate investigations.

> "Pollution is the key. Too much pollution will kill the base of the ecosystem, then the system will fail."

> "It has been proven, pollution has destroyed our waters."

> "[There is] more pollution now from development, people, factories. The changes happened to the shallow waters first, then moved out."

> "Big problems that have caused a lot of the change are man's pollution from mosquito spraying, chemicals, fertilizers, etc., and the sheer number of boats on the water with outboard motors. ...The government tells the crawfishermen they can't dip their traps in oil, yet they do nothing about outboard motors which put more oil in the water than the traps ever did. You still have the pollution from oil."

> "It seems as though there was more pollution and sewage was coming into Florida Bay from 1980 to 1985 because I found more fish with problems. ...The biggest threat to the environment is from man himself. Besides pollution, man's technology and the sheer amount of people on the water are the big problems."

In the middle Keys, water from Florida Bay apparently has a strong influence on water conditions near the Keys.

> "Off Marathon, I watched green water come down from the Gulf. [The water] had suspended particles in it. The more nutrients [in the water], the

greener the water and the more particulate in it."

"Water coming from the ocean into the Bay is better for diving and fishing than water coming from the Bay to the ocean. I used to be able to fish both tides, now I can only fish one tide. The big change occurred off Marathon in 1985 and 1986."

RAILROAD FILL AND CIRCULATION

The flow of water in and around the Keys was changed radically by construction of the Overseas Railroad and Highway. Several interviewees and well-regarded historical accounts referred to these changes and their effects. Many of the people who raised this issue, especially the long-time residents, said they recommended more openings in the highways to allow water to flow underneath.

"I used to be able to go from Manatee Bay to Long Sound [at the northern end of the 18-mile stretch] by boat before the railroad and road were put through. The railroad promised a trestle. When the road was built, they promised that the trestle would remain so there would continue to be navigation. The road went in and a culvert was placed where the trestle used to be, approximately a mile from the county line. The 18-mile stretch area used to have water that would sheet flow across on high tide. There used to be a navigable creek into Lake Surprise in the 1930s and 1940s."

"Channel 5 and 2 [bridge areas] are the major water flow ways between Florida Bay and the ocean. The area of Indian Key Fill used to be completely open shallow water area. Due to the construction of the railroad, the upper Bay was sealed off until 1935 when the hurricane hit. Prior to 1935, the railroad land was all fill, no bridges from Lower Matecumbe Key to Key Largo."

Residents of the Keys noticed effects of the causeways as early as the 1930s. In recorded interviews, Russell Niedhauk blamed the causeways for multiplying the damage caused by the 1935 Hurricane:

"...because of the changes made by the building of the railroad on the land [that blocked] natural channels and outlets, especially where Indian Key Fill is presently located, the winds blew the ocean in. [Huge] waves were trapped [on the oceanside] by the railroad with no place to go. Mother Nature had worked hard on those channels for a healthy flow of the sea and man wreaked havoc on himself by damming them up to fit his needs."

As told in *Charlotte's Story* (c.1934), Charlotte Niedhauk asked Capt. Russell of Key West where the best sponge beds were. Capt. Russell replied:

"Hard to say exactly. Things got all changed around after Flagler put in his railroad. When he put in his fill beds on mud flats, he disturbed the natural flow of water. It started new beds and ruined a lot of good ones [sponges] in the old beds. No good can come out of man changing the natural flow of water like that. If we ever get a big blow like we got in 1906, it will just ruin the sponges. Stagnant water trapped where it never was before -- when that gets mixed with the rest, something bad is sure to happen."

Before there was much development in the Keys, high tides flowed across some part of what is now US 1.

"[There is] no flushing in the northeast Florida Bay area like it used to be due to lack of water. Just north of the county line along the 18-mile stretch there are two small culverts in the road. [They] don't do much. In the old days the water used to sheet flow across that area. I used to be able to go from Barnes Sound to the Bay through where the highway is now. The railroad also filled Delta Creek and Little Snake Creek. My daddy said that the railroad fill would kill people because it blocked the natural water flow, and it did -- the 1935 hurricane."

CANALS

Interviewees who lived on a canal system, or who frequented canal systems, were asked if they noticed any changes to the water clarity or quality. Everyone claimed that water in canal systems used to be clear, but is now "muddy" or "green." Almost all interviewees were of the opinion that the water conditions in the canals became worse because canal-side development increased.

"I do not swim in the canals in residential neighborhoods, due to the septic tanks and the leaching associated with them. ...The canals are much worse now. Correlates with the development of houses. As more houses went up and more people moved into the houses, the canals got greener."

"The canal in front of our house [on Summerland Key] was cut in 1969. The water was clear and the cut was full of life. There were very few houses on the canal then. As development occurred and people started moving into the homes on a full-time basis, the canal started to silt in and the marine life disappeared."

"In 1986, I used to swim in our canal on Big Pine Key everyday. There were very few houses on the canal then and the water was clear. Two to three years ago, with the increased development and year-round use of homes on the canal, long strands of yellowish green rope-like algae became dominant. There is a change in the way the bottom looks now."

Weather also plays a significant role in the water conditions of the canals. Several people said after a lot of rainfall, the color of the water in the canals is green and visibility is poor.

"Tropical Storm Marco caused the water in the canal to turn lime green."

People also said marine life in the canal systems has changed.

"The canals used to be crystal clear. You could see 18 feet down into a canal and see crawfish under an old rusted car [lying] at the bottom."

"I'm very discouraged. Fish have abandoned our canal on Big Pine Key [western shoreline]. When we first bought our home, the canal was full of life. Today the canal is dormant. The only time we see any snapper, pinfish, or barracuda is after there has been a lot of rain in lower Florida [because the fish are 'passing through']. For years, in early December, the mullet came in [to the canal system] to spend the night, but this year [1992] I saw one solitary fish. We're now afraid the water is dangerous to swim in."

"I used to be able to catch tropicals and invertebrates, like seahorses, in the canals. No longer."

In the upper Keys, one person said the problem with his canal system is its depth.

"I live on a deep canal that is dead. It's an open [to the Bay] canal that was dug too deep – 40 feet deep. [This canal has] strong sulfur odors."

NEARSHORE AREAS

Almost all comments on nearshore waters reflected a decline in water clarity, a change in water color, and more turbidity.

"I see a lot more particulate floating around in the nearshore waters, which causes visibility problems. The water [in the nearshore areas of Key West and islands to the west] used to be crystal clear. The last three years, the shallow patch reefs near the small islands have become undiveable due to poor water clarity."

"When it is windy, the water gets milky white in the nearshore areas due to the resuspension of particulate. It does not settle out as quickly as it did in the past. The area immediately adjacent to the islands is dirty."

"From the 1930s to the 1960s, the water used to be clear and clean in the nearshore, bight, and harbor areas [of Key West]. When I came back [to Key West] in 1989, I noticed that wasn't the case anymore."

"In the 1970s, the water at Mallory and in the harbor was clear."

"At Long Key Lab, [which is on the open water of Florida Bay] four to five years ago [1988 or 1889], I started seeing a change in the visibility."

"There seems to be a lot more sediments in the nearshore area [of Long Key] now, a real fine grey sediment. ...It has been ten years now that we haven't had 'gin-clear' water in the shallows. [There are] increased nutrients in the water now than in the past."

"The color of the water along the shoreline of the Keys and the mainland is all wrong now. The shoreline water used to be a translucent blue. Now, in the middle and parts of the upper Keys, the shoreline is a yellow brown. You have to go to the lower Keys to get the blue water along the shoreline."

Several people said besides the change in the clarity and quality of the water in the nearshore areas, there has been a decline in the marine life.

"The flats on the south side of Summerland Key used to be nice and clean. Now there is a lot of silt. The flats have really changed, including the marine life, which no longer is there."

"The flats off Big Pine Key [Pine Channel] look like a desert. The speed boats keep the bottom stirred up and the spongers hook up tiny sponges that they sell at the flea market, therefore the fish have no place to hide."

Two people commented on water clarity associated with the Key Colony Beach sewage treatment facility.

"The Key Colony Beach basin used to be clear and full of life until the sewage treatment plan was installed and began operating. We watched as, through the years, the area died and silted in."

One person gave an historical account of the waters in Barnes and Card Sounds in the upper Keys.

> "In the past, the water in Barnes and Cards Sounds was really dark along the shoreline, a tannic color, and it was not clear. You had to know where the banks and bars were in order to maneuver a boat. You couldn't operate by sight."

FLORIDA BAY AND THE EVERGLADES

Florida Bay is an estuary affected by freshwater flows from the Everglades watershed. The two principal surface flowways are Shark River Slough and Taylor Slough, although groundwater may be equally important to freshwater deliveries into Florida Bay.

In a diary entry dated January 3, 1857, Mr. William Hackley of Key West wrote:

> "The calm weather has lasted so long that the fresh water from the Everglades has drifted down to the Keys. The fishermen say that yesterday in the N.W. Channel [near Key West] the water was fresh enough to drink and that they did drink full draughts of it. The water at the wharfs and in the harbour this morning has the greenish tinge peculiar to the water near the coasts of the mainland. The fish continue to die in great numbers and all kinds – king fish, mullet, morays, trunk fish, grunts & c. lined the beaches making a horrible stench and the water is covered with them dead and drifting out with the tide."

A few days before the diary entry a cold front went through the Keys, but the author felt that the large fish kill was due to other causes. The weather apparently was exceptionally warm and the winds light for most of November and December 1856.

Charles Brookfield of the Audubon Society explored Florida Bay in the 1920s. He is responsible for most of the names of the various islands and banks. In an article written by Love Dean, Mr. Brookfield describes Florida Bay:

> "The colors of the water have never ceased to amaze me. Shades of turquoise curve next to bright green pools. The mauve mud flats make a lacy maze around the emerald green mangrove islands and crystal clear green waters shoal into beige along the shallows. Where the mangrove islands stretch around the sounds and bays, the tannin acid from their roots and fallen leaves turn the water a rich reddish brown. In storms the water is opaque. On calm days the bottom looks only inches away; sponges, grasses, gorgonians seem held within a tinted green glass case."

Daniel Beard's report on Everglades National Park (1938) commented on water clarity in Florida Bay:

> "...the waters of Florida Bay from about the vicinity of Little Madeira Bay eastward did not appear as milky as further west. ...The eastern part of Florida Bay does not seem to have as much material in solution as the western part. Spongers and commercial fishermen have said the same thing and point to the clear waters outside Key Largo as compared to outside the other keys (on the Atlantic side). ...Clear water is found in Florida Bay only when there has not been a great deal of rain or wind."

One person who grew up mullet fishing in the Bay gave the following historical account:

"In the winter time, Florida Bay was rarely clear. Northeast Florida Bay was pale white. It used to be muddy all the time, like a milk color. [There was] zero to very little vegetation [in northeast Florida Bay] because there was no light penetration. The crustaceans lived in the mud and the mullet kept it stirred up."

Other people commented on changes in weather patterns over the Everglades and Florida Bay, and related it to the drainage system and lack of freshwater flow as sources of Florida Bay's problems.

"The biggest change is the change in weather patterns and the draining of the Everglades. Big storm squalls would dump a lot of rain which would flush the Everglades, which were the breeding grounds for many species. Never used to run out of rainwater in our cisterns [in Islamorada] because we had a lot of rain. ...In the 1950s, I had a fishing camp for 15 years in the Everglades. Always had ankle deep water around the camp. ...Snake Bight used to be nice and clear, now you cannot tell the flat from the channel. [There is a] lot more sediments [in the Bay] now. A very fine, brown silt mush. ...Deterioration of the Bay started with man's changing of the system. The headwaters of the Everglades are the Kissimmee. I see a direct correlation between man's work in the Everglades and Kissimmee and the decline in Florida Bay."

"The relationship to the water conditions in the Bay and the lack of big storms is that when you go to the bathroom and never flush it, what are you going to get?"

"The [change in the] water flow is what caused all of the problems. My dad, who is 78 years old, fished in Florida Bay in the winter of 1935, and like he says, all one has to do is look at the maps and aerial photos since 1950 up to 1986 and see how much development, canals, etc. that have taken place and how the Water Management District has let the water run out into the Atlantic instead of going through the Everglades."

Everyone who commented on Florida Bay said the Bay has declined significantly.

"The color of the water in Florida Bay used to be every shade of blue and it used to be full of life. Taylor Slough had at least three to four feet of water flowing from it that was tannic in color. In the early 1970s, you could go up the river [Taylor Slough] in a boat until the vegetation stopped you."

"I'm seeing a constant water quality problem in Florida Bay now. In the 1960s, while traveling back and forth between Flamingo and Marathon, we had crystal clear water all the way across. You could see the bottom and every blade of grass; the water depth averages 8-12 feet. I would look for the rock holes and wouldn't even get into the water until I determined that there were enough fish to catch. I could see the fish by sight from the boat. In 1985 and 1986, I observed a drastic downhill change in water clarity in the Bay."

"In the winter of 1973 and 1974, I started seeing a gradual change in the Bay with the worsening of the clarity of water. This got progressively worse. From 1973 to 1979, along the park boundary near Sandy Key and East Cape, you gradually couldn't see the bottom in areas where you used to be able to. Prior to 1973, the water was always clear. In the last five years, the bottom has gotten progressively

> worse in that area and the decline has escalated."
>
> "From 1981 onward, the water started getting cloudy. We started having a hard time seeing the bottom of the Bay. Used to be that as you were pulling up your trap you could see what was in it. It changed so that you could only see a foot down into the water."
>
> "The water quality has declined so bad that it has chased the fish away from the Bay. I used to be able to sight the areas where you would put your traps, not anymore."

One person, however, claimed that digging early drainage canals on the Florida peninsula had a positive effect on fishing in Florida Bay:

> "Northeast Florida Bay never had a tide difference, which was good for mullet but that's it. Start to get a tidal difference and influence [in Florida Bay] around Snake Bight. ...In 1917, canals were dug in the Cape area for drainage. Before the ditches were dug, fishing was not that great. Afterward, once the ditches opened and connected all the lakes to each other, the fishing became phenomenal. The Cape was not productive before the canals were dug. Afterward they were. The Everglades National Park plugged the canals and there was a big fish kill. ...There used to be a shallow entrance and exit at Russell Key [in Florida Bay] so that water would flow in and out. Fish would go in at night and out by day. Now that area has shallowed in and the fish can not move."

Several people commented on the impacts of the C-111 canal (Aerojet Canal) in Florida Bay.

> "My uncle, who lived in Flamingo, said that when C-111 was put through in 1967 or 1968 things were going to change, because there is not enough current in east Florida Bay to mix and flush the area. It used to be, when you drove up the 18-mile stretch during the rainy season you could look to the west and see the water flowing through the grass. Since the C-111 was built, I haven't seen that."

Regarding Taylor Slough, a fishing guide said:

> "When I first started guiding in the Keys, the old guys would tell me stories about the number of fish in Florida Bay and I'd ask them why there weren't as many there now. After they finished giving me a hard time about my not knowing where the fish were, they all said one thing, 'there's not as much fresh water back there.' ...When we tried to find the outlet for Taylor River Slough into Florida Bay, we couldn't find it. I've been there twice since then. There's a good reason we couldn't find it; it's not there anymore. And in the 1950s and 1960s, the guides used to fish that river five miles upstream for largemouth bass."

A few people talked about the flow of water in western Florida Bay. They agreed that:

> "...under East Cape, water flows from the northwest to the southeast. South of that area, from the Park, it's an east to west flow of water. At the Sprigger/Oxford Bank area, the flow of water is southwest to northeast."

About Florida Bay and its potential impacts to the Dry Tortugas, one commercial fisher said:

"The volume of water passing through the channels of the Keys is far less than the volume of tidal water that goes through Tortugas. Florida Bay effects will take a long time to hit Tortugas. Where it might take ten years to get the impacts of Florida Bay to Key West, it will take it another ten years to get to Tortugas, if it can get past Rebecca Channel."

In the upper Keys, interviewees believed the construction of the Marvin Adams Waterway connecting Largo Sound with Blackwater Sound damaged northeast Florida Bay by opening a direct connection to ocean water.

"Salt water never really flowed into the upper Bay. Now it flows like crazy due to the Adams Waterway cut."

"The Marvin Adams Waterway shouldn't be there. According to the old timers, the waterway has ruined the shrimping and the water flow in the Sound."

"Water used to flow across where Key Largo Fisheries and Charles Point [Key Largo] is now on a high tide. Water also flowed across US 1, the area where the Blue Heron trailer park is now. US 1 is like a dam as are US 41 [Tamiami Trail] and Alligator Alley in the Everglades."

"There used to be a lot of flow of water into the Bay from the mainland. You didn't have to go up the creeks far to get fresh water. A couple of years ago, just north of Shark River at Broad River when the tide had just switched to incoming, I was able to get fresh water at the mouth of the river."

OCEAN-SIDE AND THE REEF TRACT

Historically, residents and visitors to the Keys viewed the reef through glass-bottomed pails. The water was so clear that it was easy to observe reef life from the surface. Fishing, too, was done largely by sight. In *Adventures With Rod and Harpoon Along The Florida Keys* (1925), Wendell Endicott describes fishing along the coral reef:

"I wonder also if there is any spot where the waters take on such varied and marvelous colors. ...There in the waters you see a golden yellow, edged by a pale light green; here you see the colors of topaz; there you see the shadings of an emerald; here an olive green; there a Nile green--and out beyond is the deep liquid blue. A cloud drifts over the sun and the colors change. ...Perhaps when you 'put out' for the reef, the water will be calm and clear and on the way you will pass over some 'rock beds.' These are the nautical gardens. And gardens they are indeed. No hand of man ever wrought such indescribable displays of artistry. Looking through glass-bottomed pails, you gaze at untold beauty."

Many interviewees said the visibility on the reef has gradually declined. They claim particulate matter in the water column on the reef has increased, as have sediments that are easily stirred up and resuspended in the water column.

"Sand Key [off Key West] used to always be clear until the Key West sewer outfall was put into Hawk Channel. The water is milkier now than in the past. It's not crystal clear anymore. A

lot more suspended particles are in the water now. The closer to Key West island you go from offshore, the greener the water."

"We have noticed that since the Key West pipeline was built, there has been a major decline in water clarity, quality and the 'pristineness' of the coral reef. A lot more particulate in the water column now."

"In the past the water was always 'gin clear.' The change became noticeable off the Lower Keys in 1986 and was gradual. Now seeing more white particulate matter in the water column."

Many people also said their benchmark for "great visibility" has changed. They claim that in the "old days" 40 feet of visibility was considered bad; now it is good. It was once more common to have visibility of 100 feet. There are fewer clear days now.

"In 1975, on the reef in the lower Keys during the winter, the water clarity averaged 100 feet for three months. A bad day was having only 25 to 40-feet of visibility. The water was gin clear."

"[There are] less days that the water is clear now. It used to be crystal clear, now [the water] has a haze to it, cloudy. The green water is further out now, oceanside."

"Now after a rain the water doesn't settle out as quick. We are not getting the crisp, clear water. Seems like the green water of summer is lasting longer. In the early 1980s, we didn't have the murkiness in the water. Seems as though it became really noticeable [on the reef off Key West] in 1990."

"The water quality and reef problems have been around for over ten years now. Have we waited too long?"

A few people commented on water clarity in Hawk Channel.

"I used to be able to see the bottom of Hawk Channel off Marathon, almost all the time. In 1956 and 1957, it was like being on air, the surface of water was not distinguishable from the air. The water used to be clear in Hawk Channel in the summertime. Could see every blade of grass, every shell. The water was clearer than gin. Now, the water is greenish with algae in it. Before, Hawk Channel did not have a color. Also, there is now a lot of silt in Hawk Channel washed from the shore area from the dredgers."

"In 1972, I could clearly see a lobster trap in 30-40 feet of water in Hawk Channel."

"In the early 1980s, Hawk Channel started becoming dirty. Now it is very difficult to find a clear day to go diving in the Channel."

Two people commented on water clarity associated with the Key Colony Beach sewage treatment facility.

"The Key Colony Beach basin used to be clear and full of life until the sewage treatment plant was installed and began operating. We watched as, through the years, the area died and silted in."

One person gave an historical account of the waters in Barnes and Card Sounds in the upper Keys.

"In the past, the water in Barnes and Card Sounds was really dark along the shoreline, a tannic color, and it was

not clear. You had to know where the banks and bars were in order to maneuver a boat. You couldn't operate by sight."

OTHER SPECIFIC AREAS

One commercial fisher, who spends most of his time fishing near the Dry Tortugas, said he has not noticed a change in the water conditions there. The only changes he has observed were the "normal" changes he associated with weather. Recreational fishers from Key West also said they have not observed any long-term changes in the water conditions off Key West.

In *Outhouses To Computers,* Willy Roberts describes a boat trip he took in the 1920s from Key West to the Marquesas.

> "I made one such trip to Marquesas Keys with my Father. ...on my Christmas vacation from school. ...Deep water, as I remember, was of a dark blue. The water over and long the banks was various shades of green ranging from the darker hues to the pastel lighter colors, each reflecting so vivid in the morning sun."

A commercial diver who spends a lot of time west of Key West and near the Marquesas claimed the water clarity has declined.

> "I saw the bottom in 20 feet of water more often in the past than now. ...Clarity in the shallow areas was more dependent on weather in the past. ...The Northwest Channel [off Key West] is not diveable anymore. This year [1992/1993, the decline in water clarity] was real obvious. It took a real dive. In the past there was a gradual change in water clarity. The last few years, the change has been rapid. At Boca Grande [east side of Marquesas], only get clear water with an incoming tide [ocean to Gulf]. When the tide switches to outgoing, water from the Gulf is pushed toward the reef area and the clarity goes downhill, lots of particulate. ...In the winter the water would be clear with wind driven sediments that settled quickly. The change started to become obvious and severe starting in the mid-1980s."

One person, a charter fisher, also said water clarity has declined off Key West:

> "In the bay areas of the lower Keys, the water is dirtier and cloudy. Not as clear as in the past. It has been a gradual decline for the past seven to eight years. The clarity is also bad in and around Marquesas. Boca Grande has gotten muddy where you cannot see the bottom anymore. Even the blue water is not as clear. It's now hazy."

People from the lower Keys (outside Key West) associated water quality declines with too many people and too much development.

> "In the past, the water was clear more often. The problem is too many people. The water is rarely clear now. It used to be crystal clear off Loggerhead Key [just south of Cudjoe]. The sponges are now all gone and the water is now murky. In the past there were more clear water days in a year, now we have less clear days. Even in the nearshore areas it is hard to sight tarpon in three to six feet of water due to suspended particles and the lack of clearness of the water. Overall, in the backcountry the water is dirtier. Also, once the new and improved bridges were finished, water clarity started to decline."

> "[There has been] a very gradual change in water clarity. Going from Coupon Bight [Big Pine Key-ocean-side] to Looe Key in the spring of 1979, I could see everything, each blade of grass, sponge, the abundance of the critters."

In Daniel Beard's report on the proposed Everglades National Park project (1938), he says:

> "A foreman working on the Isle of Dreams development within the northern boundary of the park is a native of Bermuda and a veteran of the tropical seas. He said that the waters outside of the upper end of Key Largo are always clear (a fact borne out by numerous fishermen and spongers) as contrasted with the lower sections of Key Largo and other places along the Upper Florida Keys."

LAYERED WATER

Several divers noticed areas of layered water, where the water would be "dirty" or cloudy at the surface and clear on the bottom. Some divers have also seen the reverse, where the clear water is above. The divers described these events as thermoclines or, in some cases, like thermoclines but without a noticeable temperature difference.

> "...[I] have had it once in the Gulf [during the summer] where the water was hotter on the bottom. Normally in the Gulf, way offshore, you get clear, hot waters on the surface; then 30 feet up from the bottom, you get dirty, cold water that moves in a different direction. In the summertime in Hawk Channel, you get hot water on the bottom."

> "Two summers now [1991 and 1992], I noticed a water inversion off the middle Keys out to Alligator Reef. [There was] hot, salty water on the bottom, 95° at one point. There were white, hydrogen sulfide type bubbles coming up from the reef, [and I saw] dead fish and gorgonians. Normally the inversion area would have brown, fresh water on top with clear, blue water on the bottom. In the inversion area, I saw two dead rock beauties and three dead large tangs. All had clear eyes and were limp. The cardinal fish were skinny and emaciated."

> "Before the March 1993 storm, there was a definite thermocline on the reef in shallow water off Key West. At the surface, the water temperature was 75° and below the surface 15 feet down the temperature was 71°. On March 22, 1986, the water temperature in that same area was 46°. ...I noticed a hazy murky water layer on the reef off Key West this year for the first time ever."

SPRINGS

Several people said there were once freshwater springs at Rabbit Key Basin in Florida Bay, but they were unsure if they still existed.

One person said he was told of a spring at the north tip of Big Pine Key, off Watson's Hammock. The "old timers" told him that manatees congregated there, but the springs disappeared once the mosquito ditches were dug in the hammock. He believed the ditches may have stopped water from flowing into the head of the spring.

Another person had heard of a freshwater spring on Molasses Key, but he never found

it. He had also been told there were springs off Big Pine Key and in Gulf waters in 30 and 180 feet of water. Despite searching, he never observed any spring in either of these two locations.

One person said he first observed a spring in February 1966 west of Sable Creek, in 42 feet of water. This spring was still active in 1987.

Another person said he found a circular hole ringed with "white algae" beneath 15 feet of water in Sawyer Channel (north of Big Pine Key). He saw water flowing out of it; the water was cold, and tasted like sulfur.

ALGAE* AND RED TIDES

*None of the scientific names for algae used by interviewees have been verified by the author.

Algal Blooms in the Keys

All interviewees said that algal blooms have always occurred in the Keys, but they also agreed that blooms have become larger and more persistent. Almost everyone recognized two main varieties of algal blooms in the Keys -- masses of macroalgae that cover the bottom, and blooms of phytoplankton (microscopic algae) in the water column.

Boaters and fishers recognize "algae blooms" in the water column as patches of green, opaque, or cloudy water, although these conditions don't always indicate a nuisance increase in algae.

Lobster and net fishers, especially, notice macroalgal blooms because the algae cover the trap lines and traps and become entangled in nets.

Fishers working out of Key West said they never had a problem with macroalgae in the past. Now some have noticed algae on their lines. Several people also mentioned macroalgae blooms in the Dry Tortugas. One person said that on the south side of the islands in 1985 and 1991, "...a brown, slimy grass-like algae was all throughout the water column."

Most of the interviewees from the lower Keys and Key West agreed that algae have increased on the reefs, especially in the summer. Divers noted seeing more *Dictyota,* a yellow-brown algae, covering the sea bottom west of Key West. They speculated the increase was due to excess nutrients in the water from "development and the sewage treatment plant."

One interviewee said there were some macroalgae that covered patch reefs in Hawk Channel out to Tortugas Hump in the summer of 1988 or 1989. This person did not recall the color or type of algae. His log book simply noted that there were algae covering the patch reefs. In 1991, he saw stringy, brown macroalgae covering the same area.

In March, July, and August 1993, green phytoplankton were observed south of the Marquesas Keys, on the reef tract. Several people claimed that visibility was reduced almost to zero. In the late 1970s through 1980s, there were short-lived green algal blooms in the water column in this area, but only during the summer. These people noticed that the blooms last longer.

> "There have always been patches of green water in the summer west of Key West -- small algae blooms associated with hot water. Now the blooms are more intense and more often."

> "The more nutrients, the greener the water, the more particulate matter in it."

One person said that in the early 1970s, the waters near Racoon Key and Loggerhead Key (Key Lois) were clear before the Charles River group moved Rhesus monkeys onto those islands. Now mangroves have died, and there is an abundance of brown algae in the nearshore areas surrounding the islands.

A commercial fisher observed a different kind of bloom in Gulf waters off Cape Sable:

> "In 1967 or 1968, I remember blooms associated with the Gulf Loop current and water coming down from the north in 30-50 feet of water. When you started seeing the flying fish very active inshore, that meant get your traps out of the water because the current was coming inshore and with it, algae."

Another person observed an algal bloom in the backcountry of the lower Keys every summer in the 1970s. This person first saw green, filamentous algae in 1971, on the area called the 'Rock Pile,' north of Big Pine Key. This algae is locally called "gumbo" and is characterized as a stringy, hairlike, slimy green algae.

> "There has always been a bloom since the 1970s on the 'Rock Pile.' Two to three years ago [1991 or 1990], the gumbo algae was really bad on the 'Rock Pile.'"

In the Gulf, north of Big Pine and Summerland Keys, one trap fisher had problems with gumbo in August and September 1973 or 1974. He said that in the late 1970s, gumbo was uncommon, but not now.

> "Gumbo ruins nets and when you pull a trap that is covered with gumbo, the crabs and lobsters are dead."

This person felt the death of the crabs and lobsters was due to being smothered by the algae. Also, since the 1970s, there has been an increase in "rolling moss" (brown algae) that fills the traps and causes the buoys to "disappear."

Two people commented on algae in the middle Keys (outside of Florida Bay). One said that "every so often" stringy, green algae collected on traps he had placed in nearshore waters by the sewage facility at Duck Key. Although the area smelled, he said, he could still catch crawfish. The other person noted an increase in sea lettuce algae (*Ulva*) along the bay side of the highway and near the Keys Marine Lab.

Red Tides in the Keys

Several comments were collected on red tides. One person said every four or five years for the past 30-40 years, there was a red tide from Cape Sable going west to Harbor Key, just north of Big Pine. This usually lasted from a week to a month. The last red tide in that area was approximately five years ago (1988).

> "Right before World War II, near Harbor Key and the Content Keys, there was a bloom that the locals called a red tide. It totally denuded the bottom, killed coral, fish, etc. When I went back to that area five to six years later, the area had recovered."

In the summer of 1970, two interviewees observed a red tide in the Key Colony Beach basin area that lasted for three days. This red tide killed all the fish in the area. A few people said that red tide occurred with stagnant water conditions.

In *Charlotte's Story*, Charlotte Niedhauk, while living on Elliot Key north of Key Largo, describes a 1935 red tide:

> "It wasn't too long after the Labor Day Hurricane of 1935 that we first heard of the Red Tide. This disease almost decimated the sponges as well as killing uncountable tons of fish. The sponge fishermen had slim picking in the Keys for many years."

Algal Blooms in Florida Bay

For ease of discussion, Florida Bay was divided into sections: northeast Florida Bay, Florida Bay proper, and western Florida Bay. Drawing an imaginary line running from Little Madeira Bay (east of Taylor Slough) down to Plantation Key, the eastern portion would be northeast Florida Bay and the western portion would be Florida Bay proper. The western boundary of Florida Bay proper is the Everglades National Park (the Park) boundary. Western Florida Bay runs from the Park boundary over to an imaginary line that runs from northwest Cape Sable to Harbor Light Key, just north of Big Pine Key.

The chronology of algal blooms in Florida Bay is summarized in Table 5.

There are two main algal bloom areas in Florida Bay. One bloom is located in western Florida Bay along the boundaries of the Park, moving to the west and south. This bloom area is well known by the commercial fishers and is called "the dead zone." The other bloom, which originated in the Park area and is characterized by its pea soup green color, is well known by the fishing guides.

Several long-time residents and fishing guides claimed there were always small, short-lived blooms in Florida Bay:

> "Up to 1978, there were no real changes in the Bay. ...always had small algae blooms. First noticed [the blooms] in the early 1950s. It might have been going on prior to then but I did not fish that area until then. In the late fall and winter in the 1950s, I saw algae blooms near Buchanan Keys and Arsnicker Keys. One year [in the 1950s] it got close to Crab Key and Long Key. I would notice these blooms when chasing mullet with a cast net for bait. I could catch mullet in the bloom, which was the color of pea soup."

> "There have always been small harmless algal bloom areas in the past. They were no bigger than 5x5 miles and seemed to be associated with weather. Usually, [I] would see the bloom near Sandy Key, off of the Capes. I used to see a macroalgae, which would pull the trap buoys down and would kill gorgonians [and other similar invertebrates] by smothering them. The algae would get real thick in the traps and chase the lobster away. It would fill the trap all the way to the funnel! This algae was also called 'rolling moss.'"

Another individual remembered seeing pea green water in Rabbit Key Basin in 1981 or 1982.

Commercial fishers have been very vocal about the "dead zone" algal bloom:

> "In 1981, the water got dirtier, the blooms grew, and the seagrass started dying. I could see dirty water and algae pouring through from the Park at Carl Ross Bank/Rocky Channel cut. The Oxfoot/Sandy Key area was the worst area for the red moss, right along the park boundary. ...For years, I did not realize what was going on until 1985, when I started seeing large areas

of seagrass die-off. In 1985, I also started seeing a change in the kind of algae blooms. There was no rhyme or reason as to why or when or which algae would be dominant. Normally, it is a warm weather bloom but it is now happening year round. ...From 1981 to 1986, the decline [of the Bay] was gradual. In 1987, the Bay started to collapse quickly."

"The commercial fishermen saw the water [in western Florida Bay] changing – first by becoming dirty, then algae blooms started, and then seagrass died off. ...The fish that were normally found in these waters are staying at the edges of the bloom in the clear water. The blooms used to be macroalgae blooms, now [we're] seeing more microalgae blooms. All of the algae blooms drive fish away."

"In the dead zone there are no baitfish, no birds, no life. Fish are right on the edge [of the bloom]. Last year, the bloom came right into the bayside canals [of the middle and part of the upper Keys] and turned the water a soupy, chocolate milk color. When it cleared out, I could see all that was left was dead bottom."

"In the last five years, the bottom has gotten progressively worse in [the dead zone] and it has escalated. Everything [fish and lobsters] are moving to the west ahead of the bloom. The bottom now in [the dead zone] went from seagrass and clean sandy areas to areas of real black silt. Because of the bloom, fish and lobster are either avoiding the area or moving through it rapidly. Two to three years ago [1990 or 1991], the rolling red moss became a major problem by filling up the traps and weighing down the buoys. ...Pilots have seen the bloom for years in the Park area. It is moving southwest."

"In 1972 or 1973, I first noticed a real algae bloom approximately ten miles west of Sandy Key. For several years after, had the same type bloom in small areas. ...The actual size of the algae bloom is not what is being mapped. A lot of the so-called bloom area is actually from kill-off, dead bottom area, silt and mud mixed with the algae. For years, scientists denied the problems that we were seeing in Florida Bay."

TABLE 5: Chronology of Algal Blooms in the Florida Bay Area.

1948-1950	A fishing captain said he saw an algal bloom in the area of Rabbit Key, Arsnicker Keys, Twin Keys and Ninemile Bank. The bloom only lasted one to two months. "It seems like every five or six years there would be an algae bloom [in that area]. The fish were still there but you couldn't see into the water. The University of Miami took samples."
1950's	Fall and winter, a fishing captain said there were algal blooms near the Buchanan and Arsnicker Keys.
1967 or 1968	A commercial fisher said there were algal blooms associated with the Gulf Loop current and the water coming down from the north during the last two weeks of stone crab season.
1972 & 1973	A commercial fisher noticed an algal bloom approximately ten miles west of Sandy Key.
1973-1975	Fall, a commercial fisher noticed muddy water between Sandy Key and East Cape, and caught more catfish. "The water used to be clear and never caught catfish there; used to catch snapper and trout and the bottom had a lot of gorgonians."
1973-1979	Along the Park boundary near Sandy Key and East Cape, the water gradually became dirty.
1978	A commercial fisher first started seeing a bloom in the "dead zone" area (off of Cape Sable). "It was a red algal bloom, south and west of Cape Sable. ...in the late 1970's, we watched areas of traditionally pristine water develop a green tinge. By 1979, we started witnessing the development of macro-algae blooms."
1981	Another commercial fisher started noticing the water getting dirtier and the first red macroalgae blooms in the western Bay area.
1981 or 1982	Several people encountered a green algal bloom while diving off Rabbit Key Basin. This bloom reduced visibility to less than six inches.
1983	The commercial fishers first observed a seagrass die-off in the dead zone area, west of Sandy Key.
1985	Major seagrass die-off in western Florida Bay. The pink shrimp industry's annual harvests dropped significantly.
Pre-1987	There was a "mud" area nearshore between Middle Cape and East Cape.
Post-1987	The mud moved south and west. Some fishers said they saw the first bloom off Cape Sable and Sandy Key in August 1987. Since 1987, most agreed the area south and west of Cape Sable and Sandy Keep rapidly collapsed.
1987	Fall, a fishing captain said he first saw algal blooms in the Bay at Sprigger Key and up to Oxfoot Bank.

1988 or 1989	The mud area near Sandy Key grew and moved toward the south, to just west of Oxfoot Bank and Sprigger Keys. "All the grass died. The water looked like dirty brown soup. No grass, no fish, and no more huge drifts of seagrass."
1990	Several commercial fishers said there was an algae bloom near Islamorada, at Cotton Key, that resulted in a lobster and fish kill. One person said there was an algal bloom near the Keys Marine Lab at Long Key. This bloom did not last long, and consisted of very fine brown/green particles in the water column. "Schooner Bank was clean but you couldn't see the bottom at Oxfoot Bank."
1991	In western Florida Bay, commercial fishers noticed the algal blooms switching from macroalgae to microalgae. An algal bloom within the Park was noticed at Sandy Key basin and Sandy Key bank.
1991 - 1992	The first year the algal bloom in the Park never left the Bay. Prior to 1991, the bloom would disappear when the water cooled.
1992	Visibility at Schooner Bank declined. "Two and a half feet of water [at Schooner Bank] turned a mustard color. If you go toward Ninemile Bank, the water was clean." In April or May, commercial fishers noted, "The water was like green egg-drop soup" from Ninemile Bank to Sprigger Bank, and came from the Park area of Florida Bay. There was a massive *Ulva* bloom that clogged the strainers on the commercial boats. At the Keys Marine Lab, there were 16 days of algal bloom along the shoreline and only six inches of water visibility. The algal bloom caused a decline in sponge habitat, a major nursery area for shellfish.
1993	An algal bloom was observed coming from the Park area of Florida Bay and crossing the reef tract, at least seven nautical miles offshore. In January and February, a commercial diver said, "...green bloom water from the Bay came moving over the reef quickly, at least three to four knots. My eyebrows and eyes burned and itched."

MARINE DEBRIS

Interviewees were asked if they saw more or less garbage on the reef, in the mangroves, or on the water. They also were asked if they noticed a change in the type of debris over the years.

Most people said they saw an increase in the number of plastic bags in the offshore weedline. One commercial fisher said:

> "Sometimes the whole weed line is made up of garbage bags. This is dominant offshore, about 30 miles out [from Marathon]."

Historically, fishers found wooden planks and boards that were used as slats for cargo. Several people said there are fewer planks now, especially off the Tortugas. Also, some people said it was common to find 55 gallon drums floating around until the early 1980s. They also saw more oil on the surface of the water then.

Most interviewees said it was common to find plastic bags (such as ice and bait bags), chum boxes, and paper towels floating on the water and settled onto the sand and reef bottom areas. These observations have increased in the past few years, and are probably related to increased boat use in the Florida Keys.

Another side effect of increased boat traffic and usage of marine resources is the increased amount of lost gear. Most of the divers interviewed noticed an increase in the amount of monofilament line entangled on the reef and especially on wrecks; they said those wrecks were a hazard for divers. Also, there were more observances of lost commercial gear, primarily traps. A few people said they saw more broken or lost traps in the water because fishers are putting out more gear.

Almost all the interviewees saw more garbage (everything from bottles, cans, lobster buoys, and rope to light bulbs) along the shoreline. They said it was especially noticeable along the backcountry islands of the lower Keys and in the ocean-side mangroves throughout the Keys.

Some people said they found large quantities of bleach bottles (with labels) in the mangroves and under bridges.

Although spongers are accused of using bleach to clean sponges on their boats, commercial spongers interviewed said the technique creates a very low quality product and is not used.

Interviewees were asked if they knew of large, manmade objects in the water not associated with an approved artificial reef. Several people said that people in the Keys used to dump appliances, cars, trucks, and machinery in the water. Common dumping places included borrow pits and deeply dug canals and basins. Shipwrecks and derelict vessels are also common.

Old traps and other debris have been placed in the water for the creation of lobster habitat. In some older, undeveloped canals it was not uncommon to find the hoods of vehicles stacked along the bottom to attract lobster. Old metal drums and construction debris were also used.

Several people, particularly the flats fishers, complained of the increased numbers of spongers and their mother boats. They said that more areas, especially the lower Keys, were being "trashed" by sunken dinghies and garbage associated with the liveaboard mother boats.

Water Quality

Many interviewees have seen, either on the water or along the shoreline, remnants of rafts used to escape from Cuba. These observations increased dramatically in the past few years.

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The public support for this project was overwhelming. Many people offered information via an interview. Unfortunately, there was not enough time to interview everyone who was willing to share information. Names of people not interviewed for this report will be kept in a file for future use.

Please mail comments about the report to: Paul Dye, Director of Marine Conservation, Florida Keys Initiative, The Nature Conservancy 201 Front Street, Suite 222, Key West, FL 33040.
Reference: Anecdotal Report

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ABOUT THE AUTHOR

Karen Kennedy DeMaris is a consulting biologist with experience throughout the state of Florida. She has worked on the marine ecosystem, wetlands, and tropical hardwood hammocks of the Florida Keys, and has experience in fisheries research. Ms. DeMaria holds Bachelor's Degrees in Marine Biology and General Biology, and has previously worked as a biologist for the State of Florida and the U.S. Army Corps of Engineers. Her volunteer work includes judging fishing tournaments and helping several environmental organizations. She resides on Summerland Key with her husband, Don DeMaria, a local commercial fisherman/diver who works out of Key West.

APPENDIX A: SPECIES AND HABITATS REFERENCED IN THE INTERVIEWS

During the interviews, lists of species and habitats were used to assist people's memories and ensure the accuracy of their comments. Scientific names for some species are included here to augment common names, which can vary from place to place.

FISH AND OTHER VERTEBRATES

Sharks and Rays
Bonnethead shark
Lemon shark
Nurse shark
Tiger shark
Mako shark
Bull shark
Blacktip shark
Whale shark
Sawfish
Stingrays
Other

Moray Eels
Green moray
Spotted moray
Other

Groupers
Black grouper
Red grouper
Warsaw grouper
Gag (Gray grouper)
Yellowmouth grouper
Yellowfin grouper
Tiger grouper
Snowy grouper
Nassau grouper
Jewfish
Other

Jacks and Pompanos
Greater amberjack
Yellow jack
Bar jack
Crevalle (Crevalle jack)
Horse-eye jack
Permit
Blue runner
Rainbow runner
Florida pompano
African pompano
Other

Snappers
Yellowtail snapper
Gray (Mangrove) snapper
Mutton snapper
Red snapper
Cubera snapper
Dog snapper
Schoolmaster
Lane snapper
Hogfish (Hog snapper) [Wrasse family]
Other

Mackerels and Tuna
King mackerel
Spanish mackerel
Cero (Cero mackerel)
Wahoo
Albacore
Bigeye tuna
Blackfin tuna
Bluefin tuna
Bonito
Little tunny
Skipjack tuna
Yellowfin tuna
Other

Billfishes and Swordfish
Sailfish
Blue marlin
White marlin
Swordfish

Bait Fish
Ballyhoo
Mojua/Glass minnows
Spanish sardine
Pinfish
Pilchard
Other

Butterflyfish and Angelfish
Foureye butterflyfish
Banded butterflyfish
Spotfin butterflyfish
Reef butterflyfish
Longsnout butterflyfish
Queen angelfish
Blue angelfish
Gray angelfish
French angelfish
Rock beauty
Pigmy angelfish

Other Fish
Bonefish
Tarpon
Ladyfish
Trumpetfish
Houndfish
Flying fish
Trunkfish/Cowfish
Puffers
Sergeant major
Damselfish
Porgy
Sheepshead
Redfish (Red drum)
Spotted sea trout
High hat
Bluefish
Tilefish
Blueheaded wrasse
Spanish hogfish
Cuban hogfish
Other wasses
Cardinalfish
Squirrelfish
Jawfish
Blennies
Grunts
Dolphin
Blue tang
Surgeonfish
Triggerfish
Filefish
Parrotfish
Barracuda
Cobia
Remora
Snook
Mola mola

Other Vertebrates
Manatee
Porpoise (dolphin)
Caribbean monk seal
Sea Turtles:
- Loggerhead
- Hawksbill
- Green
- Kemp's Ridley
- Leatherback

INVERTEBRATES

Sponges
Sheepswool sponge *(Hippiospongia lachne)*
Yellow sponge *(Spongia barbara)*
Grass sponge *(Spongia graminea)*
Loggerhead sponge (*Spheciospongia vesparium*)
Black ball/Stinker sponges (*Ircinia spp.*)
Branching tube sponge (*Pseudoceratina crassa*): varies in color
Brown tube sponge (*Agelas conifera*)
Giant barrel sponge (*Xestospongia muta*)
Branching vase sponge (*Callyspongia vaginalis*)
Fire sponge (*Tedania ignis*)
Rope sponges (various species)
Encrusting/Boring sponges (various species)
Other

Octocorals/Gorgonians
Sea fans
Sea whips
Sea plumes
Sea rods

Corals
Branching fire coral (*Millepora alcicornis*)
Blade fire coral (*Millepora complanata*)
Black coral (*Antipathes spp.*)
Wire coral (*Cirrhipathes leutkeni*)

Stony Corals
Elkhorn coral (*Acropora palmata*)
Staghorn coral (*Acropora cervicornis*)
Finger coral (*Porites porites*)
Mustard hill coral (*Porites astreoides*)
Mountainous star coral (*Montastrea faveolata*)
Elliptical star coral (*Dichocoenia stokesii*)
Starlet corals (*Siderastrea spp.*)
Flower coral (*Eusmilia fastigiata*)
Golfball coral (*Favia fragum*)
Rose coral (*Manicina areolata*)
Lettuce corals/Sheet corals (*Agaricia spp.*)
Brain corals (*Diploria spp.*)
Pillar coral (*Dendrogyra cylindrus*)
Ivory tree/bush corals (*Oculina spp.*)
Other

Hydroids (various species)
Giant anemone (*Condylactis gigantea*)
Ricordia (*Ricordia florida*)

Jellyfish
Portuguese Man-of-War
Moon jelly (*Aurelia aurita*)
Cannonball jelly (*Stomolophus meleagris*)
Upside-down jellyfish (*Cassiopea spp.*)
Sea walnut (Comb jelly) (*Mnemiopsis mccradyi*) [Ctenophora]

Mollusks/Shells
Queen conch
Horse conch
Helmet conch
Other conchs: Milk, Hawkwing, Florida fighting, Roostertail
Triton's trumpet
Hairy triton
True tulip (*Fasciolaria tulipa*)
Olives (*Oliva reticularis* and *O. sayana*)
Cowries (various species)
Flamingo tongue (*Cyphoma gibbosum*)
Spiny (Thorny) oyster (*Spondylus americanus*)
Fileclam (Flame scallop) (*Limus spp.*)
Atlantic pearl oyster (*Pinctada radiata*)
Wing oyster (*Pteria colymbus*)
Mangrove oyster (*Isognomon alatus*)
Other bivalves

Sea hares
Sea slugs
Nudibranchs
Chitons

Squid
Octopus

Annelids/Worms
Feather duster worms
Christmas tree worms

Crustaceans
Lobster:
- Spiny Lobster
- Shovel-nosed Lobster

Shrimp:
- Pink shrimp
- Pistol shrimp (*Alpheus spp.*)
- Large claw snapping shrimp (*Synalpheus spp.*)
- Arrow shrimp (*Tozeuma carolinense*)
- Peppermint shrimp (*Lysmata wurdemanni*)
- Cleaner shrimp (various species)
- Banded coral shrimp (*Stenopus hispidus*)
- Other

Crabs:
- Blue crabs
- Arrow crabs
- Hermet crabs
- Spider crabs
- Coral crabs
- Calico crabs/Decorator crabs
- Stone crab (*Menippe mercenaria*)
- Other

Other Arthropods
Amphipods
Isopods: parasites attached to fish
Sessile barnacles

Goose-neck barnacle
Horseshoe crab

Echinoderms

Sea stars/Starfish
Brittle stars
Giant basket star (*Astrophyton muricatum*)
Sea urchins:
- Long-spined urchin (*Diadema antillarum*)
- Pencil urchin (*Eucidaris tribuloides*)
- Variegated urchin (*Lytechinus variegatus*)
- West Indian sea egg (*Tripneustes ventricosus*)
- Sea biscuits
- Sand dollars

Sea cucumbers
Crinoids

Other Invertebrates

Bryozoans
Tunicates [chordates]

MARINE PLANTS

Seagrasses

Turtle grass (*Thalassia testudinum*): flat, wide leaves
Manatee grass *(Synringodium filiforme*): thin, round leaves
Cuban shoal grass (*Halodule wrightii*): thin, flat leaves
Widgeon grass (*Ruppia maritima*): branched leaves, perfers brackish water

ALGAE

Sargassum seaweed/Sargasso weed (*Sargassum spp.*)
Y-branched alga (*Dictyota* spp.)
Leafy algae (*Padina spp.*)
Watercress alga (*Halimeda opuntia*)
Bristle brush/Merman's shaving brush (*Penicillus dumetosus*)
Green grape alga (*Caulerpa racemosa*)
Fuzzy finger alga (*Dasycladus vermicularis*)
Sea pearl (*Ventricaria ventricosa*)
Green net alga (*Microdictyon boergesenii*)
Mermaid's fans (*Udotea spp.*)
Blade algae (*Avrainvillea spp.*)
Pine cone alga (*Rhipocephalus phoenix*)
Mermaid's wine glasses (*Acetabularia spp.*)
Pink bush alga (*Wrangelia penicillata*)
Reef cement (*Porolithon pachydermum*)
Fuzzball algae (various species)

HABITATS

Shoreline and Nearshore Areas

Fringing mangrove areas
Mangrove islands
Mud flats/Mud banks
Sandy shoals and sand bars
Macroalgae-dominated areas (merman's shaving brush, mermaid's fan, pinecone algae, fuzzy finger, sea pearl, etc.)
Sparse seagrass beds (describe grasses)
Dense seagrass beds (describe grasses)
Hardbottom communities (mixed: corals, soft corals, sponges and algae)
Patch reefs/Coral heads: isolated coral areas, usually surrounded by sand halo and seagrass
Tidal channels
Canals
Dredged areas
Freshwsater springs/Sinkholes/Solution holes

Offshore Areas (Hawk Channel and Beyond)

Hawk Channel
Mud bottom
Unvegetated sandy areas
Macroalgae-dominated areas (merman's shaving brush, mermaid's fan, pinecone algae, fuzzy finger, sea pearl, etc.)
Sparse seagrass beds (describe grasses)
Dense seagrass beds (describe grasses)
Offshore patch reefs/Coral heads: isolated coral areas, usually surrounded by sand halo and seagrass

Reef tract (by common name, e.g., Grecian Rocks, Looe Key, American Shoals, Sand Key)
Back reef (back slope): area behind bank reefs (closest to land), calm and protected
Spur and groove: ridges of coral with sand channels on fore-reef and reef crest
Reef crest: top of reef
Fore-reef: seaward slope from reef crest to deeper water
Intermediate to deep reef: 33 to 65 feet
Hardbottom communities beyond deep reef: mixed corals, sponges and macroalgae to about 100 feet
Deep water and wreck sites over 100 feet
Gulf Stream

APPENDIX B: ANECDOTAL AND HISTORICAL TIME LINE

DATE	HISTORICAL	ANECDOTAL
1714	Carysfort ship sinks at the reef now bearing its name.	
1744	HMS Looe runs aground at what is now known as Looe Key National Marine Sanctuary.	
1762	Florida under British control.	
1784	Florida under Spanish control.	
1700s	Many families move from the Bahamas to the Keys.	
1800s	Eastern Key Vaca (Marathon) has a population of more than 100 people.	
1819	Spain gives Florida to the United States.	
1821	Florida becomes a U.S. Territory.	
1822	John Simonton buys the island of Key West. Navy ship USS Alligator runs aground at the reef now bearing its name while chasing pirates. (The lighthouse stands almost on top of the wreck site.)	
1825	Lighthouse built at Garden Key (Dry Tortugas) Congress requires salvage from wrecks in U.S. waters to be brought to an American port of entry for arbitration. Prior to 1825, salvage was taken to ports in Nassau and Havana. First self-contained diving outfit invented by William James.	
1830	517 persons lived in Monroe County, nearly all residing in Key West.	
1830	Salt manufactured in the Key West salt ponds. Abandoned in October 1876 due to hurricane.	

DATE	HISTORICAL	ANECDOTAL
1830s		Key West becomes one of the richest cities in Florida.
1832	First city charter of Key West	
1835	September: major storm hits Key West causing groundings and wrecks on the reefs.	
1836	Dade County established. Indian Key is the county seat.	
1837	"Hard hat" suits invented for diving by Augustus Siebe.	
1840	Indian Key is attacked by Indians. Residents move back to Key West. 688 people reside in Key West.	
1845	Florida becomes a state.	
1846	October: Great Key West Hurricane, which destroyed the Sand Key and Key West lighthouses. Construction of Fort Jefferson (Dry Tortugas) begins.	
1849	Start of sponge industry in Key West.	Large motherships tow strings of dinghies to work the sponge grounds.
1850	2,645 people reside in Key West.	
1851	Louis Agassiz, while onboard the Bibb, conducts a reef survey for lighthouse locations. Among the first scientific reef studies.	
1852	Carysfort Reef lighthouse built.	
1853	Sand Key lighthouse rebuilt.	
1855	Population of Key West is 2,700.	

DATE	HISTORICAL	ANECDOTAL
1856	November and December: Key West experiences exceptionally warm weather and light winds.	December: from the diary of William Hackley, "the beach area of Key West is strewn with millions of dead fish of all kinds. The fish lie dead for several days from decay." Mr. Hackley stated that the cold did not kill them because the weather was not that severe. He felt that they died from some sort of disease.
1857		January: from the Hackley diary, "the Northwest Channel (off Key West) has so much fresh water that fishermen can drink it." It was thought that the fresh water came from the Everglades because there was a long period of calm weather. "The water at the wharfs and in the harbor has a greenish tinge, similar to the water near the costs of the mainland. All kinds of fish continue to die in great numbers."
1858	Sombrero Key lighthouse built.	
1860	Population of Key West is 2,832. Small settlements increasing throughout the Keys.	
1861	During the Civil War, federal troops occupy Ft. Jefferson, which is half completed.	
1867	August to November: yellow fever is rampant at Ft. Jefferson.	
1868	Thousands of Cubans flee to Key West because of the war in Cuba.	
1870	Alligator Reef lighthouse built. 5,657 people reside in Key West.	
1876	October: a small hurricane hits Key West.	
1878	Fowey Rocks lighthouse built.	
1879	Northwest Passage lighthouse built.	

DATE	HISTORICAL	ANECDOTAL
1880	American Shoal lighthouse is built. 9,890 people reside in Key West.	Key West becomes the "cigar capital of the world."
1880s	The area now called Islamorada was founded and called "Pinderville."	
1881	Everglades Drainage District is created. Work involved the Lake Okeechobee area to Caloosahatchee.	
1882	First land sale on Big Pine Key.	
1886	Rebecca Shoal lighthouse rebuilt. April: great Key West fire.	
1887	Regular steamship service is established between Key West, Havana and Tampa.	
1889	First electrical plant opens in Key West.	
1890	**Key West is the most populous city in Florida, with 18,080 residents.** First turtle cannery and factory built in Key West. First ice plant built in Key West.	
1890s	Key Largo settled.	Approximately 500 men and 130 boats of all sizes and varieties are employed in sponging.
1892	Small sponge market established in Tarpon Springs.	
1892		350 boats engaged in sponging, working out of Key West.
1894	September: a storm hits Key West, causing slight damage.	
1895-1896		Winter temperatures reach 32°F several times in Miami.
1900	17,114 people reside in Key West.	Fishing becomes the predominant occupation for Keys residents.

DATE	HISTORICAL	ANECDOTAL
1901	Dr. H.F. Moore of the Bureau of Fisheries establishes a small station on Sugarloaf Key in order to experiment in the controlled raising of sponges.	
1902		Preston Pinder becomes one of the first fishing guides in Islamorada.
1904	Henry Flagler announces plans to build the Overseas Railroad from Miami to Key West. Population of Key West is 17,114.	
1905	Construction of Overseas Railway begins.	Fishers notice an increasing number of malformed sponges. Sometimes the entire sponge would disintegrate when touched.
1906	October: hurricane hits Long Key and the upper Keys. Key Vaca (Marathon) is the site of a large railroad camp.	Long Key Fishing Club is created by Flagler's East Coast Hotel Company. The club is later destroyed by the 1935 Labor Day hurricane.
1909	October: hurricane hits the middle and upper Keys.	
1910	September: hurricane hits lower Keys. 19,945 people reside in Key West.	
1910-1915	Sugarloaf Key is the most populated of all the Keys outside of Key West. Big Pine Key, with two families, is second.	Charles and George Chase buy most of Sugarloaf Key and form the Florida Keys Sponge and Fruit Company.
1912	Overseas Railway opens in Key West. It was completed in 1916 at a cost of $49 million.	Many think the island of Key West will grow due to the opening of the railroad, but the opposite is true. Families begin moving up the Keys to find breathing room and opportunities for fishing, sponging, and farming. The town of Chase is created on Sugarloaf Key in association with the Florida Sponge and Fruit Company plant. Fishing camps open in the lower Keys (Pirate's Cove and Perky's of Sugarloaf).

DATE	HISTORICAL	ANECDOTAL
1916	Work begins on Tamiami Trail from both coasts.	Florida Sponge and Fruit Company of Sugarloaf Key is bankrupt.
1917	U.S. formally enters World War I.	Canals dug in the Cape area for drainage, and Florida Bay fishing is said to improve. Sponge disease hits the lower Keys.
1918	Everglades Drainage District was formed. First ice house built in Key West (Thompson's).	
1919		First lobster regulations established.
1920	The 18th Amendment is passed (Prohibition), and rum running begins in the Keys. (Key West was never closed to drinking.) Population of Key West is 19,350.	Active freshwater spring in Biscayne Bay.
1920-1930		"Do not remember seeing large numbers of *Diadema* (sea urchins) on the banks."
1923	According to a fisheries report, the United States' largest clam beds exist off the coast of south Florida in the 10,000 Islands area between Gullivan's Bay/Cape Romano to Shark Point.	
1926	A hurricane blows the water out of Lake Okeechobee and drowns many people. Soon afterwards, the Army Corps of Engineers begins building a dike to hold the water in the lake.	October, large lobster crawl observed off Elliot Key.
1927	Grassy Key and Key Vaca (Marathon) each have approximately 27 inhabitants.	Bad year to catch lobsters in the upper Keys.
1928	The Tamiami Trail Highway officially opens after 13-years of construction. Built across the central Everglades with a walking dredge, the highway becomes an impediment to the southward flow of water.	

DATE	HISTORICAL	ANECDOTAL
1929	Work is completed on the Miami, Hillsboro, and North New River canals, which drain the Everglades. Stock market crash.	The canals overdrained the area and did not provide for adequate flood protection during heavy rains.
1929-1930		Winter, temperature reaches 32°F several times in Miami.
1930	Great Depression begins. Population of Key West is 12, 831. Ft. Jefferson named a national monument.	No lobster in Key West. Crawfishers in Miami and upper Keys strike for more money. Price goes from three to 15 cents per pound by year-end.
1931		Scientist growing conch pearls in Key West
1932		Unusually cold winter. Lobster "leave the Keys." Catch stays low through 1935.
1933	Yves LePrieur, a captain in the French Navy, invents a diving system that utilizes the new technology of compressed air.	
1934	State of Florida promotes tourism to revive the economy of Key West.	
1935	September 2, the great Labor Day hurricane hits the Keys. Eye crosses the Islamorada area.	Seventeen foot high waves crash over the railroad track in Islamorada, which is only seven feet above sea level. Forty-two miles of roadbed are washed out. Mangroves in the middle Keys destroyed.
1936	Flood Control Act of 1936 gives the Army Corps of Engineers federal responsibility for flood protection.	
1937-1938		Winter is very dry.

DATE	HISTORICAL	ANECDOTAL
1938	Overseas Highway is opened, constructed on top of the old railroad system.	"Saw big red shoals of lobsters swimming off Key West." "Clear water is found in Florida Bay only when there has not been a great deal of rain or wind." Commercial fishers object to the inclusion of Florida Bay in Everglades National Park. Sport fishing reportedly not as good in Florida Bay proper as in nearby waters.
1939		Sponge blight kills sponges throughout the Keys. Winter: severe cold front hits the Keys. Temperature down to 41°F.
1940		Lobster traps begin being used in the Keys. County law limits each fisher to 220 wooden-slatted lobster traps.
1940-1945	Navy pipeline brings water from mainland wells to Key West. Civilians not allowed to hook up until after the war. Navy creates an air field on Boca Chica Key during WWII.	Commercial fishers are paid five cents per pound for lobster in the middle Keys. Algae bloom observed in the areas of Rabbit Key, Arsnicker Key, Twin Keys and Ninemile Bank. Queen conch population "plentiful." Northeast Florida Bay "muddy all the time, a pale white muddy clay." Red tide near Harbor Key and Content Keys kills sponges and fish.
1941-1942	Population of Key West is estimated at 14,000.	
1942	Jacques Cousteau develops the aqua lung.	
1943	Monroe County Commission issues an order halting the practice of drying shark skins on the No Name Key Causeway. (Shark processing plant at the time is located on the eastern shore of Big Pine Key.)	August, 818 pounds of jewfish are caught off Pigeon Key in the span of 90 minutes. Two people catch the fish while fishing from the Seven-mile Bridge. The largest of the six fish is 280 pounds, the smallest is 16 pounds.
1944	October: hurricane hits the Key West area.	

DATE	HISTORICAL	ANECDOTAL
1945	Military boosts population of Key West to approximately 45,000.	Becomes illegal to catch bonefish in nets and seines.
1946		Sponge blight kills sponges throughout the Keys.
1946-1947		Major flood in Ft. Lauderdale/Miami area. Two big storms move through the Key Largo area the first six weeks of lobster season.
1947	Delbert Layton founds city of Layton (Long Key). December 6: Everglades National Park established (authorized May 10, 1934).	
1947 or 1948		Large lobster crawl observed off Elliot Key.
1948 and 1950		Square wooden lobster traps become popular in the Keys
1948	Movie "Key Largo" is released. Army Corps of Engineers and the State of Florida start work on a comprehensive plan for flood control in central and south Florida. Small hurricane locally called "Hurricane Conchita," hits the lower Keys and Key West.	Hall's Fish Camp opens in Marathon.
1949	South Florida Water Management District (SFWMD) is established.	Pink shrimp discovered off Tortugas. Beginning of the "Pink Gold Rush."
1950	Central and south Florida flood control project begins. Tavernier has approximately 250 residents. Marathon has nearly 1,000 residents.	Florida Keys Aqueduct Authority expands water lines. Population outside Key West grows. One-acre lots being sold on Big Pine Key for development.
1950-1955		Whitewater Bay, which used to be white and one of the most productive fishing grounds, "turns brown."

DATE	HISTORICAL	ANECDOTAL
1950s	Organized efforts in mosquito control begin. Monroe County provides diesel-based mosquito spray for residents. Navy begins aerial mosquito spraying.	Researchers from the University of Miami, led by ecologist Durbin Tabb, warn of environmental changes caused by the shortage of fresh water in the Florida Bay region. Stable population of scallops located in the basin between Rabbit Key and Man of War Key. Fall and winter: a recurring, short-lived algae bloom near Buchanan and Arsnicker Keys. Commercial fishermen paid 25 cents per pound for lobster. Mechanical pullers used in the lobster fishery. More people join the fishery. Population of *Diadema* on the reefs is "massive." Fishing guides fish five miles upstream in Taylor River Slough for largemouth bass.
1952	Monroe County Mosquito Control District created.	Last known Caribbean Monk Seal in the Florida Keys is killed near Key West.
1954	Levee is built from Lake Okeechobee to Miami to keep Everglades water to the west of the city.	Key West ocean outfall sewage pipe is built. Opening into the shipping channel in 20 feet of water; this pipe pumps raw sewage from the city of Key West into the ocean.
1955-1976		"Can see the bottom of Florida Bay" regularly.
1956 and 1957		"Being on Hawk's Channel on a boat is like being on air - can see the bottom."
1957		An especially cold winter
1959	The Los Angeles County Department of Recreation is the first organization to have a regional diving certification program. As recreational diving catches on, other organizations, (YMCA, NAUI and PADI) join in, and national certification cards become mandatory.	
1959-1961	Cuban Revolution, immigrants move to the Keys.	

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1960	September 9-10, Hurricane Donna hits Marathon and the upper Keys. The eye moves over Long Key and the western coastline of south Florida. John Pennekamp Coral Reef State Park is created. Dedication in December 1960.	Vaca cut created. Hurricane Donna wipes out all of the tall mangroves next to Shark River, near Flamingo, and in the middle Keys.
1960s	Height of Army Corps of Engineers construction activity in south Florida.	Traveling back and forth between Flamingo and Marathon, Florida Bay water is "crystal clear all the way." Stone crab industry increases. Muddy, sparse *Halodule* seagrass beds are present in northeast Florida Bay. A lot of lobsters are caught in international waters and landed in Monroe County. Scallop boom in Florida Bay north of Lower Matecumbe Key in the late 1960s. The scallops stay for about two years, then vanish. The first lobster traps are placed in Florida Bay. Mid to late 1960s: a decline in the amount of fish in the upper and middle Keys in the nearshore waters, bayside.
1960	Marvin Adams Waterway in Key Largo constructed. Keys' zoning laws are established.	
1963	Mosquito Control District buys planes and starts aerial spraying.	
1965		Approximately 27 shrimp boats are working out of Marathon; over 300 shrimp boats are working out of Key West.
1965	Hurricane Betsy.	
1965-1974	Alligator Alley is completed. The Miami Canal is deepened.	
1966	Hurricane Inez.	
1967	C-111 Canal is constructed.	

DATE	HISTORICAL	ANECDOTAL
1967 or 1968		Algae bloom associated with the Gulf Loop current and water coming from the north observed off Everglades City.
1968 or 1970		Poor lobster catch.
1969-1970		Winter: cold water from Florida Bay kills many of the corals at Hens and Chickens Reef, an inshore-patch reef.
1970s	Charles River Laboratories begins raising rhesus monkeys on Raccoon Key and Key Lois. Daily bag limit of 10 queen conch is established.	"You could go up Taylor River (Slough) in a boat." The water at Mallory docks and in Key West Harbor is clear. Late 1970s: water clarity starts going bad, coral reefs start to decline throughout the middle and lower Keys. Short-lived green algae blooms observed in the water column at Marquesas. Increase in the rolling, moss-brown algae in western Florida Bay. Tourism and land development in the Keys, and steady increase in water/boat use. Steady population growth in the Keys and steady growth in water usage rate. Population of *Diadema* starts to decline. Mid-1970s, lobster traps at Red Bay Bank covered with "green slimy algae" and filled with "rolling moss" brown algae.
1971		Green filamentous algae bloom observed north of Big Pine Key at the rockpile. Re-occurs every summer afterward for short periods of time. Areas of traditionally clear water in western Florida Bay develop a "green tinge."
1972	Key Largo National Marine Sanctuary is designated. Indian Key and Lignumvitae Key bought by the State of Florida.	Can clearly see a lobster trap in 30-40 feet of water in Hawk Channel
1972 or 1973		Algae bloom 10 miles west of Sandy Key.

DATE	HISTORICAL	ANECDOTAL
1973		Begin seeing a gradual change in the water clarity near Sandy Key and East Cape.
1973-1975		Increase in the catfish catch in western Florida Bay.
1974-1979		More water is moved into the Miami/South Dade area for flood control. Use of liveaboard boats by sponge fishermen increases. Use of Loran by commercial fishers increases.
1975	Keys are designated an "Area of Critical State Concern" by the Governor due to rapid development and outstanding natural resources.	Winter: water clarity on the reef in the lower Keys "averages 100 feet." Coral bleaching observed on some patch reefs of the lower Keys in Hawk Channel.
1976	Federal fisheries councils are formed June: the harvest of fire coral, hard coral, and sea fans prohibited in Federal waters under the Continental Shelf Act (struck down in court in 1979). October: the United Nations designates Everglades National Park an International Biosphere Reserve.	A state report says that the individual lobster catches are down, but the total lobster landings in the Keys have increased.
1977		Hard freeze, considered to be the last real cold spell. Cold water fish kills, and staghorn coral die-offs in several shallow water areas, including the Dry Tortugas.
1978	Key West Coast Guard station opens	Shrimpers notice a significantly lower catch. It is also an extremely dry year. Red algae bloom observed south and west of Cape Sable.

DATE	HISTORICAL	ANECDOTAL
1979	October: Everglades National Park designated a World Heritage Site. Work to improve road and bridges in Monroe County begins. Monroe County is ordered to create land use plan.	Summer: Zestra barrel sponges and other large sponges in Big Pine Key shoals die. Area south and southwest of Cape Sable and west of Sand Key is a lush seagrass area (this is the area to be called the "dead zone" in the late 1980s). *Halodule* seagrass beds in northeast Florida Bay replaced by *Thalassia testudinum* (turtle grass). Development of macroalgae blooms starts in west Florida Bay.
1980	April to June: height of the Mariel Boatlift.	June and August: very hot. Canal water temperatures near 94°F. Fish are on the surface on their sides (possibly due to oxygen depletion). Some minor coral bleaching.
1980-1985	Significant increase in the population of the Keys.	A lot of mullet caught in Florida Bay have "tumors" on them. Water in Hawk Channel starts becoming "dirty". Short-lived green algae blooms observed in the water column off Marquesas. Middle 1980s, an increase in jellyfish observed throughout the Keys.
1981	Looe Key National Marine Sanctuary designated. New Seven-mile Bridge is finished; FKAA water line capacity triples.	Water clarity in west Florida Bay starts to decline.
1981 or 1982		Pea-green colored water observed at Rabbit Key Basin.

DATE	HISTORICAL	ANECDOTAL
1983	State fisheries council formed. Army Corps of Engineers starts to draw water to the L-31W canal due to increase in water going into Shark River Slough.	There is much *Ricordia* coral on top of Looe Key. By 1985/86, the *Ricordia* "moves" out of the direct flow of water moving over Looe Key and into areas of cooler water. Hot weather and warm water, sponge die-off bayside of Grassy Key and Long Key (yellow and wool sponges). July: coral bleaching observed in the lower Keys from Looe Key to Western Dry Rocks. Start of seagrass die-off west of Sandy Key. *Diadema* (sea urchin) die-off in Florida, the Bahamas, and the Caribbean. Area of green water observed in Plantation Yacht Harbor and near the Coast Guard station. Juvenile conch released at Pennekamp. Near-shore water clarity becomes noticeably bad; coral people associate it with completion of new bridges.
1983-1984		Longsnout butterfly fish become displaced; move to deeper water. Crinoids disappear from the shallow waters off the lower Keys.
1984	Freighter Mini Laurel grounds at Molasses Reef. Beginning 1984, there is a 4% per year loss of coral cover at Looe Key and Key Largo.	

DATE	HISTORICAL	ANECDOTAL
1985	Queen conch declared a protected species, moratorium on harvest.	Hurricanes Elena and Kate cause the fragmentation of corals, especially staghorn and elkhorn varieties. Approximately 750 full-time Keys commercial crawfishers. Sponge disease/blight hits the Mediterranean, driving world sponge prices up. "The productive shrimping area moved to the west. It used to start at Smith shoals. Now the productive shrimp area starts at New Ground, northwest of Marquesas." A "brown, slimy, grass-like algae bloom" observed throughout the water column at Dry Tortugas. Large areas of seagrass die-off observed in western Florida Bay. Also, a change in the kind of algal blooms is observed. Large areas of seagrass die-off near Johnson Key and East Bahia Honda.
1985-1986		Outbreak of black band disease at the Sambos. Change in water clarity observed off Marathon, bayside and oceanside. Start catching fewer fish in the Sprigger Bank area. "The gorgonians died, then the water went to hell and turned muddy, no clarity."
1986	January 1, all commercial fishing prohibited in Everglades National Park. Monroe County land use plan implemented in September.	March: water temperature off Key West is 46°F. May: outbreak of black band disease at Looe Key. Change in water clarity becomes noticeable off the lower Keys.
1986-1987		40% decrease from the average shrimp catch on Dry Tortugas grounds. Good year for crawfish catch in west Florida Bay.

DATE	HISTORICAL	ANECDOTAL
1987	August: coral bleaching observed and documented throughout the Caribbean. October: coral bleaching observed throughout the Indo-Pacific.	June: period of slick, calm, hot water. Significant coral bleaching in the Keys. Scallops move into the area called the "smokehouse" near Smith Shoals, and the shrimp move out. In 1992, shrimp return to that area and scallops disappear. Fall: seagrass (turtle grass) die-off in Florida Bay is documented in the Rankin Lake, Cross Bay, and Rabbit Key areas. Fall: algal bloom observed at Sprigger Key up to Oxfoot Bank. One of the hottest winters on record.
1987 or 1988		Water clarity and quality decline more noticeably in Florida Bay. Worms and barnacles on wooden traps begin to cause serious problems. "Phenomenal" year for crawfish catch in west Florida Bay.
1987-1990	Scientific study shows a significant increase in adult queen conch on the reef, but there is a significant decrease in juveniles in the seagrass areas.	
1988		Big outbreak of sea lice in south Florida. August: the C-111 canal (Aerojet Canal) is opened. For two weeks, fresh water flows into Barnes Sound. Major fish kills in the upper Keys follow.
1988-1989		Great bait shrimp year at Manatee and Barnes Sounds. By 1992, Manatee Bay is no longer a good shrimping area. Wooden traps in Dry Tortugas start getting barnacles. Good lobster catch in west Florida Bay. November to January: seagrass die-off observed in north Key Largo next to the Park boat dock at Sunset Cove.

DATE	HISTORICAL	ANECDOTAL
1988-1990		Drought in south Florida, much seagrass dies and decays in Florida Bay. Hard freeze in southern Florida. Coral bleaching observed on the shallow water coral heads off Key West.
1988 or 1989		"Began seeing a change in the visibility in the water along the shore line at Long Key Lab (bayside)." Macroalgae blooms cover the patch reefs in Hawk Channel out to Tortugas Hump.
1989	Water restrictions placed on south Florida residents due to drought. February: sewage treatment plant completed in Key West. Secondary treated sewage goes to the ocean via the old outfall pipe.	Summer: minor coral bleaching event, mainly hits lettuce coral in the Keys, Puerto Rico, and Lee Stocking Island (Bahamas). Mangroves and adjacent shallow areas off Key West stop "growing" and erosion from boat wakes become more obvious. Sea lice (aka "bathers itch") noticed off Key West and the lower Keys. Winter: cold and drought kills many mangroves in northeast Florida Bay.
1989-1990	Low rainfall years, high temperatures and hot water temperatures in the northern Caribbean and Gulf.	Crawfish catch in western Florida Bay declines.

DATE	HISTORICAL	ANECDOTAL
1990		High salinity levels are recorded in Florida Bay. The decline in water clarity and quality become "really noticeable" on the reefs off Key West. July and August: significant coral bleaching in the Keys. 65% of the fire coral "dies." Also hits the patch reefs and inshore corals. Algal bloom observed at Cotton Key near Islamorada. Very fine brown/green algae observed off Long Key Lab in the water column. Summer: between Man of War Harbor and Pearl Basin, north of Key West, the gorgonians, seafans, and conchs disappear from the area.
1990 or 1991		Green filamentous algal bloom at the Rockpile, north of Big Pine Key.
1990-1993		Shallow patch reefs near the small islands west of Key West "have become undiveable" due to poor water clarity.
1991	December: all sponge harvesting is stopped in Biscayne National Park. South Florida Water Management District increases fresh water flow into Taylor Slough during April and May.	January, "pea green" algal bloom in Florida Bay. Others notice blooms at Sandy Key Basin and Sandy Key Bank. Some turtle grass starts to recover in the "dead zone" areas of Florida Bay, only to die off again. *Diadema* die-off at Vestal Shoals, off Key West. Algal bloom in the water column at Dry Tortugas. Brown macroalgae bloom observed near Tortugas Hump. December: algal bloom along the shoreline off Long Key Lab exists for 4 days.
1991-1992		Algal bloom spreads throughout Florida Bay. Sponge dieoff is documented. Juvenile lobster abundance subsequently declines by more than 30%. Good bait shrimp catches off Lower Matecumbe Key near the location of the algal bloom in Florida Bay.

DATE	HISTORICAL	ANECDOTAL
1991 and 1992		Summer: water "inversion" off the middle Keys out to Alligator Reef. Hot salty water on the bottom. White hydrogen sulfide-type bubbles coming up from the reef. Dead fish and gorgonians observed.
1992	August: Hurricane Andrew hits Homestead and moves west across the Everglades, killing mangroves and flushing detritus into the water. Dry Tortugas is designated a national park.	May: barrel sponges observed dying on the reef off Marathon; sponge mortality in Florida Bay noted. July and September: extensive sponge mortality noted in Florida Bay. July: salinity levels in Florida Bay fall below sea water levels. December: sponge die-off observed on the east side of Big Pine Key. December: algal bloom along the shoreline off Long Key Lab lasts for 16 days. Visibility at Schooner Bank declines. Massive macroalgae bloom in western Florida Bay, clogs traps and intakes on boats. In Card Sound, a "white fungus" is observed growing on seagrass beds. Black band disease observed near Jewfish Basin, north of Boca Chica Key. Last Marathon shrimp boat sold. Only a few remain in Key West. Increase in decorator crabs observed on the bayside of Lower Matecumbe Key in the nearshore, shallow waters. Sea lice abundant.
1992-1993		"Tremendous amount" of jellyfish observed in Florida Bay and Boot Key Harbor. Winter: cannonball jellyfish observed off Key West and Marathon. November to January: a sponge die-off is observed 5 miles north of Grassy Key. Winter: pea-green algal bloom is observed having crossed into the ocean from Florida Bay.

DATE	HISTORICAL	ANECDOTAL
1993	"Storm of the Century" occurs in March. Storm front from Dry Tortugas moves northeast through the Gulf of Mexico. Winds are clocked at 190 mph at Ft. Jefferson/Dry Tortugas. South Florida Water Management District increases water flow into Taylor Slough on a trial basis. July: upper Mississippi River floods.	January and February: green water from Florida Bay moves over the reef tract. *Diadema* increasing in the nearshore waters off Long Key. March, July, and August: algal blooms observed south of Marquesas, on the reef tract. May, 15 horseshoe crabs observed dead and washed into a canal system on the bayside of Key Largo. July: coral bleaching documented at Sand Key, Rock Key, and Western Dry Rocks to a depth of 60 feet, and includes stony corals, sea mats, sponges, and fire corals. The sea temperature at that time was 87.6°F, indicating that the lower Keys reef tract is experiencing thermal stress. August: off Key West the water is hot and coral bleaching is observed.

APPENDIX C: BIBLIOGRAPHY

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