

TABLE 1
GROWTH RATES OF CERTAIN BERMUDA REEF FISHES

Species and size groups	% growth winter (per annum)		% growth summer (per annum)		Average field growth (prorated)
	field	lab	field	lab	
Red hind					
600 g.	20		40		38%
250-400 g.		79		247	
500-700 g.		132		273	
800-1200 g.		5			
Nassau Grouper					
700 g.			20-50		40%
Rockfish					
1000 g.					60-75%

A Survey of Spearfishing in the Florida Keys

JAMES MURDOCK¹

*The Marine Laboratory, University of Miami
Coral Gables, Florida*

IN FLORIDA, spearfishing is defined legally as "the taking of any marine life through the instrumentality of a spear, gig, or other device operated by a person submerged in the water." As a commercial method spearfishing has generally been abandoned in favor of more productive means in Florida, but it is still used to a limited extent where fish can be found concentrated in certain areas or at certain times of the year.

Spearfishing has only recently been practiced as a sport. During the period from 1930 to 1935 a few individuals began this activity in Florida as well as California, Hawaii and in the Mediterranean. The early development was mostly in California and France, and much of the equipment used today comes from these places. Basic equipment includes a diving mask, swim fins and any one of the various types of spearguns or devices.

Prior to World War II there was little interest in the sport, but during the past ten years the number of spearfishermen has greatly increased. They formed many clubs which by 1950 were sufficiently numerous and organized to hold a national competition meet at Laguna Beach, California. In 1956 a national competition was held at Marathon, Florida, under the auspices of the Amateur Athletic Union which has recognized spearfishing as a new sport.

In Florida spearfishing clubs have been formed, principally along the lower east coast and in the Tampa-Sarasota-Bradenton area.

The most common places fished by spearfishermen in Florida are the shallow waters above coral reefs, near jetties, piers and bridges, and in channels or potholes. These places formerly were fished almost exclusively by hook and line fishermen, but since 1950 an increasing number of spearfishermen have been operating there.

In 1951 the Florida State Board of Conservation requested The Marine Laboratory to make a preliminary investigation in Palm Beach County to determine whether the methods of spearfishing used were contrary to conservation

¹Contribution No. 181, The Marine Laboratory, University of Miami.

aims and practices. These conservation aims were briefly stated as the control of the exploitation of fish stocks so as to give the maximum sustained yield to all legitimate activities, whether angling or commercial fishing—whether by seining, hook and line, or spearing.

The resulting report (Brady, 1951) stated that in the case investigated there appeared to be no fundamental conflict concerning spearfishing with the above concept. Snook were the principal species involved in this investigation and the removal of snook by daytime spearfishing did not amount to a significant quantity. It was estimated to be considerably less than that of angling or of commercial fishing. It was recommended therefore that daytime spearfishing be allowed to continue. Night-time spearfishing, on the other hand, could account for single nightly catches of 500 pounds per man. This night activity accounted for the greater part of commercial underwater spearfishing. There was the strong possibility that, in the locations that were fished by spearfishermen at night, the local population might be reduced, at least temporarily, and that these activities were liable to be injurious to the purely local fishery, both commercial and angling. It was therefore recommended that underwater spearing of fish at night be prohibited.

Brady's report pointed out that while simultaneous activity of spearfishermen and anglers at certain places is possible, it is hazardous to both, and totally unsatisfactory to the angler. The sociological and economic question of whether angling, spearfishing or commercial fishing was to be encouraged at the expense of the alternative activities was brought forth but was not the primary concern of the investigation.

With increased fishing pressure by spearfishermen the Florida State Board of Conservation has found it expedient to regulate the activities of this group. Prior to 1950, Florida had few laws pertaining to spearfishing and those were enforceable only in local areas. Since this time, at least ten additional laws have imposed greater limitations on spearfishing and in 1956 restrictions were in force in 13 counties of the state.

Many of these restrictions are necessary or convenient to solve economic or social problems when simultaneous activity by spearfishermen and other groups is hazardous, or where spearfishing interferes with the accustomed practices of a majority group. Some laws prohibit the sale of speared fish; others close small areas to spearfishing, especially near bridges and in inlets where, besides conflicts with anglers, there is the danger of collision between boats and spearfishermen.

From the point of view of utilization by spearfishermen, many areas are still open in the state for them to pursue their sport and obtain a share of the catch. Many other states, however, either prohibit spearfishing entirely or do not have any appreciable amount of spearfishing owing to adverse local conditions (e.g. cold water, turbidity).

With growth of interest in this sport, and as more areas become closed to spearfishing, it can be expected that increasing effort will be concentrated in favorable areas still open to spearfishing.

Monroe County (the Keys) is a desirable area for spearfishing. This location has a submarine bank along the oceanic side of the Florida Keys which varies in width from more than three to nearly seven nautical miles. This bank is covered by less than 60 feet of water as far as its eastern edge, where it slopes down to the Florida Strait. Most of this bank lies under less than 30 feet of water. Much of this shallow inshore area consists of mud or sand bottom which can be easily seen from the surface when the water is clear. These waters

soon become turbid during rough weather, but even in calm weather this shallow area is generally not attractive to spearfishermen due to the small number of fish that can be found there.

There are, however, many patches of corals scattered along this bank. These patches and the irregular coral reef which runs along the seaward edge of this bank are favorite fishing grounds for spearfishermen. This reef reaches no great depth, and its most flourishing growth of coral lies in less than 60 feet of water. The reef extends in a southwesterly direction from the vicinity of Fowey Rocks, south of Miami, to the Marquesas, which lie beyond Key West.

The growth of interest and activity in spearfishing in this area is shown by the fact that in 1956 there were at least ten charter boats taking spearfishing and diving parties to the reefs along the Florida Keys, and about 15 fishing camps whose facilities spearfishermen used. These charter boats, with two exceptions, have been operating in this manner only for a few years. These fishing camps had few, if any, spearfishing parties before 1950.

FISHING EFFORT AND LANDINGS

In 1956 the Florida State Board of Conservation was requested by interests in the Upper Keys to restrict spearfishing in that area. This request was granted on a temporary basis. At this time, Mr. Ernest Mitts, Director of the State Board of Conservation requested that The Marine Laboratory of the University of Miami make estimates of the numbers of spearfishermen operating and of the numbers of fish they catch as a method of assessing the fishing pressure by this group.

Soon after this study was started the Upper Keys area, for which information was requested, was closed to spearfishermen. This made it difficult to collect the information sought, but data were collected on the fishing pressure of spearfishermen, the seasonal and temporary factors affecting fishing effort, the species caught and the areas fished in Monroe County.

The following facts and estimates are presented to indicate the extent of spearfishing activities in Monroe County.

During a canvass of the Florida Keys, twenty places were found where spearfishermen were known to rent, launch or charter boats for the purpose of fishing in offshore waters. Estimates were made of the total number of spearfishermen using each of these sites during the period from August 1, 1955, to July 31, 1956.

Charter boats and operators which catered to spearfishermen were located as follows:

Operator	Location	Estimate of year's total fisherman days
The Skin Diver		
R. B. Lieberg and R. Weber	Key Largo	500
R. Zimmerman	Key Largo	500
Hugh Brown	Whale Harbor, Upper Matecumbe Key	1000
Seahorse Motel		
Bartelt Bros.	Marathon	400
James Kelly	Marathon	200
Mat Ferguson	Marathon and Summerland Key	50
Ed Cizinski	Key West	200
	Sub Total	2850

**Locations where boats were rented or launched for the purpose of
spearfishing were as follows:**

Location	Estimate of annual total fisherman days
Jewfish Creek, Key Largo	20
Gulfstream Lodge, Key Largo	600
Garden Cove, Key Largo	300
Mayo's Fish Camp, Key Largo	750
Lower Key Largo (2)	500
Plantation Key	20
Matecumbe Key	260
Vaca Cut	100
Marathon	200
Little Torch Key	350
Summerland Key	250
Key West	500
	Sub Total 3850

Many species are included in the spearfishermen's catch. Groupers, hogfish, jewfish, jacks and snappers are prominent. Others such as snook, barracuda, lobster, sharks, moray eels, rays, angel fish, parrot fish and turtles are also landed.

The species of fish caught by spearfishermen are also landed by anglers and by commercial fishermen. However, the most important commercial landings in the Florida Keys are king mackerel, Spanish mackerel, shrimp and spiny lobsters, while in the hook and line sport fishery many species such as trout, tarpon, bonefish, dolphin and the bigger game fishes are taken, which are not usually caught by the spearfishermen.

There are actually four groups of spearfishermen, whose average catch per day is different.

(1) Residents of Florida who are members of spearfishing clubs:

They spend a much greater number of days fishing than spearfishermen who are not club members. Questionnaires revealed that these men spent an average of 87 days fishing during the year, (although not all this time was spent in the Keys). Their average catch was estimated to be 13 pounds per fishing day.

(2) Residents of Florida who are not members of spearfishing clubs:

These people typically spent some weekends spearfishing, making one day journeys from the Miami area to nearby locations in the Keys. They usually limit their spearfishing activities to the summer months. They either rent a boat or launch their own boat from a fishing camp. Their principal targets are hogfish and groupers. Their replies to questionnaires indicate their average catch is about 5.5 pounds of fish per day, and that they fish about 15 days during the year.

(3) Florida has also attracted spearfishermen and divers from other parts of the United States, who come to explore and fish over the coral reefs. They are from all walks of life: students, university professors, factory workers, businessmen and many other groups. Most are young men, but women, older men, and children are also represented. These people spend a limited vacation in Florida, during which time they spend several days spearfishing.

Thirty of these fishermen were interviewed. The average catch of these people was higher than the 5.5 pound estimate derived from questionnaires, and was closer to 13.5 pounds.

(4) Commercial spearfishermen: From interviews of fish dealers and from those who sold speared fish; it was learned that in the study period there were at least 20 spearfishermen who regularly sold their catches, which averaged over 100 pounds per fishing day.

From interviews with commercial spearfishermen (none of whom earn their whole income from this activity) it appears that a crew of three men, with two men fishing, and the third operating the boat, can average about 300-400 pounds of fish per day (150-200 pounds per active fisherman), fishing about two days a week throughout the year. To obtain the highest price possible for their catch some sell directly to restaurants, while others sell to fish wholesalers. The species caught by the commercial spearfishermen are mostly hogfish, groupers, and occasionally jewfish and barracuda. These fishermen also land spiny lobsters but different methods of capture are used. Although they prefer to fish in areas close to their markets, they operated along the entire stretch of keys in search of the most productive grounds. It appears that this commercial spearfishing activity has decreased in the last two years.

It was estimated that the combined activity of these groups in the Florida Keys from August 1, 1955, to July 31, 1956, totalled about 6700 spearfisherman days. The total catch landed by spearfishermen in Monroe County from August 1, 1955, to July 31, 1956, is estimated to have been 207,000 pounds, using 10 pounds per fisherman per day as a reasonable average estimate.

Estimated total landings during August, 1955 to July 31, 1956,
of fish in Monroe County, by type of spearfishing.

Type of fisherman	Fisherman days	Average catch man day in lbs.	Total landings in pounds
<i>Non Commercial</i>			
Non club members	} 5700	5.5 - 13.5	} 10 57,000
Club members		13	
<i>Commercial</i>	1000	150	150,000
TOTAL	6700	—	207,000

This estimate was obtained by multiplying the total number of spearfishing days of non-commercial fishermen (2850 charter boats + 2850 non-charter boats) by their approximate average catch (10 pounds) and combining this with the commercial spearfishing days (1000) multiplied by their approximate average catch (150 pounds day).

Some of the problems raised in the Florida Keys area by spearfishing result from the fact that the interests of the spearfishermen conflict with the interest of others. Anglers, charter boat operators, commercial fishermen, fishing camp operators, and owners of other businesses such as motels and restaurants have shown concern over this activity.

The problems of most importance to these groups may be biological, economic or social in nature. They are generally related to a certain location and may differ from place to place.

The users of the several gears, while in favor of conservation to insure a maximum catch for their gear, are often reluctant to share the broader view

held by professional conservationists and administrators that the yield should be shared by all legitimate interests.

Fishermen of all kinds generally desire a high catch per unit of effort. The more fish around, other things being equal, the greater is their catch per unit of effort. As long as they compete with similar gear, problems of competition are not usually raised. But when any new fishing method begins to operate it is subject to attack by users of other gears since its operation reduces the catch of all gears. Also, when a fishery is conducted in such a restricted location as a bridge, jetty, or reef, the simultaneous operation of several types of gear obviously does not lead to operation of any one at maximum efficiency.

Under these conditions, in order to maintain or increase their catch per unit of effort, the more powerful group usually seeks to limit or eliminate the less powerful group.

Certain interests claim that spearfishing reduces local fish populations rapidly and that if spearfishing were allowed to continue at its present rate the fish would be so diminished that other interests dependent on them would suffer. Obviously in considering the reduction of fish stocks as a result of fishing pressure there is a question of whether spearfishing or hook and line fishing is more instrumental in reducing the local fish populations. We do not have data on the relative catches of anglers and spearfishermen, nor do we know the condition of any of the stocks of reef fishes.

Some information is available on the movements and behavior of some species found in Bermuda which probably can be applied to the same species in the Florida Keys.

Bardach (1957), in a paper also published in these Proceedings, tagged fish on a small reef (2.47 acres in area) in Bermuda. Nassau grouper (*Epinephalus striatus*), red hind (*E. guttatus*) and some rockfish, (*Mycteroperca*) were the species studied. Some of the recaptures of tagged fish were made after the fish were free about one year, and other tagged individuals were observed repeatedly in the area. Bardach believes that the movements of these fish were not great. He points out, however, that for the Nassau groupers no fish over 6.6 pounds in weight was tagged and that "Nassau groupers of this size are just reaching sexual maturity and many probably move off into deeper water later in their lives." He also says that the rockfish (*Mycteroperca*) do not attain their maximum size in the shallow reef environment. For the red hind (*Epinephalus guttatus*), a small grouper which grows to about three pounds, he found that individuals occur in depths of 50 and 60 fathoms and they were found in fair abundance down to about 30 fathoms. He also states that "the sizes and species composition from deeper traps suggest a greater proportion of large to small seranids, than on the shallow reefs."

For species such as the groupers it may be that much of the stock is at depths which are beyond the usual fishing depths worked by spearfishermen and thus is not generally accessible to this gear. For those individuals living for long periods on the same shallow reef their numbers in these areas would probably be noticeably reduced by fishing pressure of spearfishermen, anglers or commercial gears.

To determine a desirable rate of fishing on these stocks would require biological information on growth, mortality rates, and the habits of these fishes, which is not available.

For many of the migratory species any decline in numbers would not likely be caused principally by the fishing pressure exerted by spearfishermen since other gears are more efficient and account for larger landings.

For example, it is estimated that there were 516,000 fisherman days of fishing by sportsmen in Monroe County in 12 months during 1955 and 1956¹. If the average catch per fisherman per day is assumed to be three pounds (probably a low estimate) the total sport catch (including spearfishing) would have been about one and a half million pounds of fish. The figure could easily be closer to double this amount.

The commercial catch of finfish (i.e., excluding shrimp, lobsters and other species) in Monroe County from July, 1955, through June, 1956, was 2,473,000 pounds².

Hence, it is clear that spearfishing accounts for a small fraction of the fish caught in Monroe County (approximately 207,000 pounds compared to not less than 4,000,000 pounds).

The sociological problem of interference between anglers and spearfishermen exists on the reefs and near bridges, and this becomes more acute as the number of fishermen increases. The potential danger of the speargun as a weapon is another social problem.

The economic question of how commercial fishermen are affected by the sale of speared fish by part-time commercial fishermen and anglers is raised. Some charter boat operators are confronted with an economic problem involving the loss, or the potential loss of their customers, due to an unwillingness of anglers to patronize a locality also patronized by spearfishermen. Or a customer may be lost because he elects to spearfish instead of angle. It is clear that certain businesses in the Keys have suffered due to the activity of spearfishermen, since some anglers are said to have avoided such areas because of their presence. However, other businesses have certainly been increased by their patronage.

No balance sheet can be struck by the author to show whether greater economic harm than good has resulted from the presence of spearfishermen in the Keys, and it is believed that too many intangibles are involved to permit any observer to make a valid judgement on this question. It was evident from the present study that this problem varied in the different areas, even within distances of a few miles.

METHODS OF REGULATION OF SPEARFISHING

There are several possible methods of regulation of spearfishing. It is assumed that it is to be regarded as a legitimate activity. The problem then involves control of spearfishing so that it will not interfere seriously with other fishing activities and will not cause damage to the fish stocks. Methods in force in other parts of the world, or which have been suggested for Florida include the following:

1. Bag limits
2. Species restrictions
3. Closed seasons
4. Gear restrictions
5. Area restrictions

Bag limits:

Bag limits have been suggested as one possible method of regulating spearfishermen. This method presupposes that the catch is too large and that a bag limit would reduce the total take. There is a good possibility that groupers

¹Appreciation is expressed to Mr. Robert Ellis, who is in charge of the Game Fish Economic Survey being conducted by The Marine Laboratory for the State Board of Conservation, for these preliminary data.

²Florida Landings

(including jewfish) have declined in certain localized areas. Other species do not appear to require protection now.

Since other gears fish the same species of fish in this area, it does not appear that any bag limits, if they are introduced, should be placed upon spearfishermen and not others. If increased fishing pressure affects the stocks of fish so that bag limits would seem advisable then spearfishermen and other sport gears should be equally restricted.

Species Restriction:

Another suggested method of regulation (which is used in California) involves prohibiting the landing of certain species of fish. This control is to prevent the depletion of species of fish that are easily caught by the spearfishermen, are not relatively abundant, and are relatively non-migratory. Groupers might fit this description, but so far are reasonably abundant except in certain local areas. Since no biological information of the type necessary to determine if any other species of the Florida fish taken by spearfishermen fit these categories it is deemed unwise to suggest such restriction at this time. In addition such restraint of spearfishing does not aid in the solution of the social and economic problems which were discussed above.

Closed Season:

In general the purpose of closed seasons is to reduce the fishing pressure or to prevent the taking of fish when these are spawning, or very readily available. These restrictions should be passed only after the usefulness of this type has been clearly demonstrated. This has not been shown for any of the species fished by spearfishermen. Social and economic conflicts would likely be heightened by using closed seasons, especially if such a restriction affects anglers and spearfishermen unequally.

Gear Restrictions:

The outlawing of certain types of spearfishing equipment is a method that has been used in Bermuda to regulate spearfishermen. Here spearguns operated by compressed air are banned on the grounds that they are dangerous. However, the air powered speargun is not the most effective gear for skilled spearfishermen and banning of this type of gear would not serve to reduce their catch.

Gear restrictions might be employed when a certain type of gear catches a larger proportion of the stock than the fishery can bear, but the banning of compressed air guns would not serve this purpose.

Area Restrictions:

Finally, it has been suggested that certain areas be set aside where spearfishing is prohibited, while other areas are allotted for the sole use of this type of activity. Area restrictions are in force in Florida at present, of course, with spearfishing being prohibited near piers and jetties, and with the northern end of Monroe County being closed to spearfishing. This latter prohibition is regarded as being too severe; furthermore, no area is given to spearfishing for their exclusive use in return for losing desirable locations.

It appears that some problems of conflict between spearfishing and angling could be at least partially resolved by allocating certain areas for the exclusive use of spearfishermen, at the same time having this gear banned from other areas.

It is suggested that more than one spearfishing "preserve" be established. The northern part of Key Largo would be one suitable area; the exact location should be decided upon after consultation with those groups concerned.

This type of regulation would keep the various groups of fishermen apart and help to eliminate social conflicts. It also might serve to increase the total use of the Florida Keys area by fishermen, thus enhancing the economic status of this area.

The elimination of fishing pressure by spearfishermen in certain areas might help to increase the catches of anglers. On the other hand the establishment of areas exclusively for spearfishing might result in an increase in the total fishing pressure there, and as has been discussed previously, this may lead to a noticeable reduction of fish such as groupers in the area, resulting in lower individual catches by spearfishermen.

Under these circumstances consideration might then be given to the placing of size or bag limits upon the spearfishermen's catch. Continuous observation of the areas would be required to determine the desirability of this.

RECOMMENDATIONS

- (1) Spearfishing should be recognized as a legitimate sport activity.
- (2) Species restrictions, closed seasons and gear restrictions are not believed to be useful in solving the problems of spearfishing in Monroe County.
- (3) Bag limits are not recommended at present.
- (4) Area restrictions, prohibiting spearfishing in certain areas, but allowing this type of fishing to have the exclusive use of other areas, is suggested as a possible control.
- (5) Night spearfishing with an artificial light should be banned.
- (6) Sale of speared fish should be banned, as should sale of all fish caught by sport anglers.
- (7) Spearfishermen should be obliged to secure a license from the State Board of Conservation, provided other types of sport fishermen are also licensed.
- (8) The information needed to decide whether conservation is being served is lacking. Catch data and biological information concerning the local habitats and the biology of the fishes found there is essential. To gather and analyze basic data would require lengthy research, but it should be started.

REFERENCES

- BARDACH, JOHN E. AND DAVID MENZEL
1957. Field and Laboratory Observations on the Growth of Some Bermuda Reef Fishes. Proc. Gulf & Carib. Fish. Inst., 9th Session.
- BRADY, WINSTON
1951. Report on Spearfishing in Palm Beach County. Fla. St. Bd. of Conservation, The Marine Lab., Univ. of Miami. Mimeo. #2012.

Progress of Recovery of the Commercial Sponge Beds of Florida

JOHN F. STORR¹

Marine Laboratory, University of Miami

THIS REPORT of progress of recovery of the commercial sponge beds of Florida is a phase of the over-all investigation of the Florida commercial sponges being carried out by The Marine Laboratory for the Fish and Wildlife Service through Saltonstall-Kennedy funds. The present paper is a progress report of the work under way.

¹Contribution No. 180, The Marine Laboratory, University of Miami.