8-1-1979

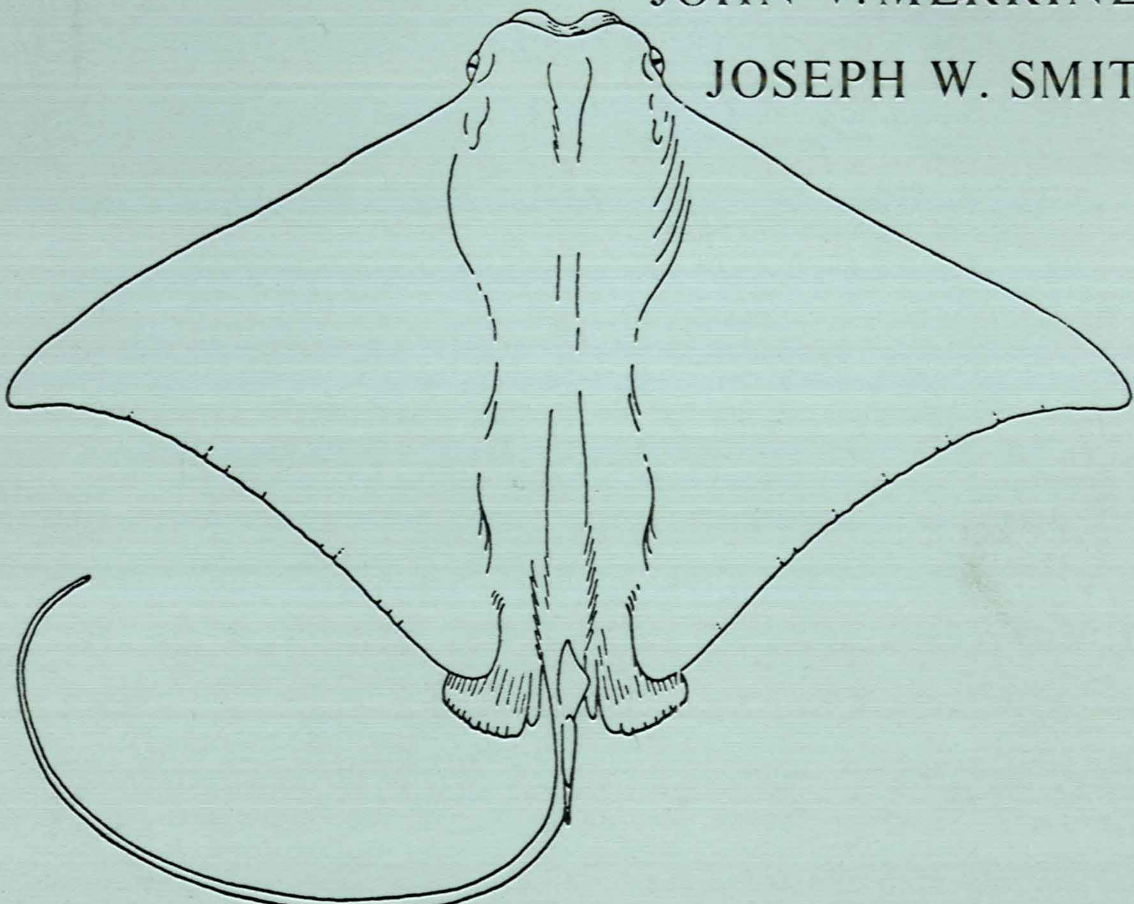
Gear Feasibility Study for the Cownose Ray, Rhinoptera bonasus

J. V. Merriner
Virginia Institute of Marine Science

J. W. Smith
Virginia Institute of Marine Science

GEAR FEASIBILITY STUDY FOR THE COWNOSE RAY, RHINOPTERA BONASUS

JOHN V. MERRINER
JOSEPH W. SMITH



Special Report In Applied Marine Science and Ocean Engineering #227

AUGUST 1979

GEAR FEASIBILITY STUDY

FOR THE COWNOSE RAY, *Rhinoptera bonasus*

J. V. Merriner and J. W. Smith

Virginia Institute of Marine Science
School of Marine Science
College of William and Mary
Gloucester Point, Virginia 23062

August 1979

Special Reports In Applied Marine Science and Ocean Engineering #227

Completion Report to Gulf and South Atlantic Fisheries Development Foundation, Inc. GASAFDFI No. 09-02-14000

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Cownose ray (CNR) predation upon private oyster grounds and clams is a recurring severe problem to the owners of the damaged resources. Research conducted under the auspices of the NOAA Sea Grant program lead to the recommendation that reduction of the ray population through increased fishing mortality would be the best long-term method to decrease the ray damage on commercially important shellfish beds. This study was to develop and evaluate an efficient gear for harvesting the rays.

Beach haul seines are effective for CNR, particularly as they are on their northward journey in the spring months and could be used by either North Carolina or Virginia fisherman without modification from their present configuration. In fact, a much shorter net could be as effective since the rays are in dense schools near shore and inside the inlets (Bardens and Oregon). Long hauling as practiced in the NC sounds is not required; a ring set is effective. The schools of rays are not easily spooked and are easily herded by the wings of the net. Use of a large mesh net in mid-summer would avoid a large by-catch of jellyfish (an oft cited problem with the smaller meshed nets. Schools of ray may be sighted by their "feeding plume" of sediment, wing tips breaking the surface, or spotter planes. Communications from the menhaden industry planes would be a very effective ray location technique.

Ray availability problems would beset a developing fishery since there are large schools in spring which break up into smaller schools as they enter the bays and rivers over the summer. Due to the established competing, products, variable local abundance, and large volume needed for shipment we feel the CNR is better suited for promotion in a smaller less-demanding, domestic market.

CNR yields approximately 1/3 saleable wing product. The residual frame may be utilized as crab bait or chum. Conventional steam cookers could process CNR into chum if cut in to 4-6 inch chunks. A formulation would have to be developed using the ray as the primary bulk, mehaden oil as slick former, and a binder.

The existing regulatory framework provides no serious obstruction to the development of a commercial fishery for CNR via gear size, mesh size, or manner of hauling. Market acceptance of the product and an economic incentive for the fisherman are the keys to development of a successful domestic fishery for CNR.

INTRODUCTION

The cownose ray, *Rhinoptera bonasus*, is a highly migratory species that resides in Chesapeake Bay from May to mid-October. Entrance and exit routes to the Bay are via the North Carolina coastline. Chesapeake Bay serves as a principal nursery and feeding ground; the young (ca. 40 cm wide) are born June to early July. Copulation follows parturition and gravid females depart the Bay with relatively large young. Adult males average 89 cm (35 in) across the disc and 11.8 kg (26 lbs). Adult females are somewhat larger averaging 96 cm (38 in) wide and 16.2 kg (36 lbs).

In 1972-1975 Rappahannock River oyster growers reported increased cownose ray predation on their oyster beds. Advisory Service contacts with these growers indicated that the problem was a recurrent one in many areas and the ray population appeared to be increasing. In 1975, eight major Virginia oyster growers solicited aid in the form of control measures to reduce the ray population.

Concurrently, Orth (1975 and 1976) pointed out that feeding cownose rays have a detrimental impact on Chesapeake Bay eelgrass beds (*Zostera marina*). Damage is often considerable resulting in reduced biological productivity, reduced sediment stability and localized erosion.

During a recent investigation (Merriner and Smith, in prep.) we demonstrated that increased cultch depth and various mechanical barriers are either ineffective or impractical as deterrents to ray predation on Chesapeake Bay oyster beds. Reduction of the ray stock through increased fishing mortality was recommended as the best long-term method of decreasing ray predations on commercially important shellfish beds. This recommendation is not unprecedented. Reduction of spiny dogfish (*Squalus acanthias*) populations has been suggested due to gear destruction incurred while fishing for more commercially valuable species of finfish (Alverson and Stansby 1963; Commonwealth of Massachusetts 1964).

In a recent utilization study, Otwell (1978) pointed out that in the absence of high domestic market demand, presently there exists no directed fishery for rays or skates. He concluded that "foreign market trends, product characteristics of domestic skate, and fishermen/processor interests indicate potential for development of a skate and ray fishery in North Carolina".

In view of the negative impacts of the cownose ray population on commercially important shellfishes and the recent, positive indications of potential foreign markets for skates and rays, the purpose of this investigation was to develop and evaluate an efficient gear for harvesting cownose rays.

PROJECT OBJECTIVES

1. Test the efficacy and efficiency of haul seines of varying lengths and mesh sizes for harvesting schools of cownose rays.

2. Investigate the alternatives available for the disposal of the ray frames in the event that a "wings off" market is developed.

3. Identify gear restriction laws in North Carolina, Virginia and Maryland which may impede the harvest of rays. Draft modifications for adoption if needed to start fishing.

Results of Objective I

Our original intent was to contract Virginia or North Carolina commercial beach fishermen and set our net on spring migratory schools of rays in April and May. However, the project was not begun until May 1. Moreover, spring 1978 was extremely cold. Chesapeake Bay and nearshore water temperatures remained abnormally low until mid-May. We observed several small catches of juvenile *R. bonasus* in haul seine catches at Carolla, N. C. in mid-May. Several beach seines reported insignificant numbers of adult *R. bonasus* in their sets of April and May 1978, as opposed to large catches of previous years. *R. bonasus* were not sighted in Chesapeake Bay until mid-June 1978.

Our net was manufactured by Nylon Net Company (Memphis, Tenn.) and was delivered in mid-June. It measured 1200 ft (366 m) long and was constructed of #48 twine with 10 in (25 cm) stretch mesh. Floats were Spongex type #SB-10 and the float line was 1/2 in braided polypropylene. The bottom line was two lengths of 3/8 in braided polypropylene with leads every 1 ft.

Originally, 25 sets with contracted commercial fishermen and VIMS vessels were planned. After mid-June due to vessel reschedulings, we were not afforded an adequate vessel until late August. Difficulty was also encountered in locating haul seine crews willing and able to fish our gear. Our primary commercial contact in the York River had his boat placed on the railway for repairs in late June, while a second fisherman contacted failed to rendezvous with us in early July.

A total of 7 sets were made in Chesapeake Bay - 5 with contracted commercial haul seine fishermen and 2 with VIMS vessels. Fishermen were paid $200/set.

Our initial set occurred on July 21 with Mr. Morris Owens of Wicomico, Va. and was the most successful set of the study. The net was loaded atop a plywood platform on the stern of a 37 ft Chesapeake deadrise. We cruised a shoal area [5-10 ft (1.5-3 m) deep] near Green Point on the York River at high slack water and sighted several cownose rays near the surface. Initially, one end of the net was secured to an anchor and placed near the shoreline. The set was made in a line perpendicular to the shoreline. The deadrise was then used to sweep the net in a U-shape around the area of ray activity with both ends of the net being close to the shoreline. A 10 ft (3.1 m) staff secured between the float and lead line of the nets' leading end kept the net spread during the sweep.

The anchor was moved approximtely 30 ft (9.1 m) from the shoreline and the trailing end of the net secured to a 10 ft (3.1 m) wooden stake implanted in the bottom. A small wooden skiff with an outboard engine was used to pull the leading end of the net past the wooden stake. Three additional stakes were implanted adjacent to the first (inside the net) to form a 15 ft x 15 ft (4.6 m x 4.6 m) square. After several runs of the skiff the trailing end of the net was "bunted" around the stakes. The netting was lashed to the stakes and a square bunt formed. The bunt was made in about 3-4 ft (1-1.5 m) of water and the set required about 1 hour.

While bunting the net a few rays were hung in the net and thrashed violently near the surface. Most of the rays however traced the net and were easily lead into the bunt. 22 rays were brailed (bailed) individually into a catch boat. Approximately 80 were released, a total catch of about 100 rays. Wings were cut from the frames manually in the catch boat. Body size and wing weight data are shown in Table 1.

The next two sets were made on the Potomac River with Mr. Charles Conklin of Mt. Holly, Va. Conklin uses four vessels for his haul seine operation - a 35 ft deadrise, two 26 ft wooden skiffs, and an aluminum skiff with an outboard engine. Considerable sandy beachfront in the area allows for catches to be hauled onshore. A capstan driven by a gasoline engine is mounted on the stern of one of the wooden skiffs ("donkeyboat") and is used to haul the net ashore.

The first of two sets was made at Coles Point. No rays were sighted after cruising the shoreline for about 2 hrs. It was decided

TABLE 1. Body size and wing weights for subsamples of *R. bonasus* from 3 successful haul seine sets (pooled data included).

Set No.	No. of Specimens	$\bar{x}$ Disc Width (mm)	Range	$\bar{x}$ Total Weight	Range	$\bar{x}$ Wing Weight	% Yield
1	22	928±73	645-1000	33.4±6.6 lbs 15.1±3.0 kg	11.6-42.0 lbs 3.5-19.1 kg	10.8±2.6 lbs 4.9±1.2 kg	32.0%
3	9	891±21	850-920	28.1±2.2 lbs 12.8±1.0 kg	24.0-31.3 lbs 10.9-14.2 kg	9.5±1.4 lbs 4.3±0.6 kg	33.8%
7	15	922±122	515-1020	34.5±9.9 lbs 15.6±4.5 kg	5.0-43.8 lbs 2.3-19.9 kg	11.4±3.7 lbs 5.2±1.7 kg	33.0%
POOLED	46	919±86	515-1020	32.7±7.6 lbs 14.8±3.4 kg	5.0-43.8 lbs 2.3-19.9 kg	10.8±2.9 lbs 4.9±1.3 kg	33%

to make a "blind" set in an area [ca. 5-10 ft (1.5-3 m) deep] where rays had been sighted several days earlier. The net was set from one of the wooden skiffs after securing the end of the net to a bulkhead near shore. A ∩-shape set was made. The donkeyboat was then positioned near the leading end of the net. A 10 ft (3.1 m) wooden staff with a bridle and a 100 ft (30.5 m) length of line was secured to the float and lead line at a point about 50-75 ft (15.2-22.9 m) from shore. The capstan was then used to haul this length of net ashore. After several hauls on the capstan a bunt was formed and hauled ashore. No rays were caught in this haul.

The second haul with Conklin was made on July 28 at Kingcopsico Point after several ray wing tips were sighted breaking the surface nearshore [ca. 6-10 ft (2-3 m) deep]. The set and haul were made in the above manner at high slack water and required about 1 hr. A total of 9 adult R. bonasus were captured. Body size and wing weight data are shown (Table 1).

Our fourth set was made on August 24 with the crew of Mr. John Dryen, Poquoson, Va. Dryden uses two vessels for his operation - a 35 ft Chesapeake deadrise and a 20 ft wooden skiff with an inboard engine ("backtow"). The set was made on a muddy patch of shoal water [ca. 3-6 ft (1-2 m)] after cruising the south side of the Poquoson River without sighting ray activity. One end of the net on the stern of the deadrise was attached to the backtow. Both vessels moved in opposite directions, the backtow towards shore and the deadrise in a J-shape arc.

The end of the net in the backtow was secured to shore with a stake. The other end of the net was walked towards the stake. After moving the stake about 30 ft (9.1 m) from the shoreline, the backtow was used to pull the net past the stake. When half of the net was bunted, the crew erected a separate "pocket" [ca. 25 ft x 25 ft (7.6 m x 7.6 m); 1 1/2 in stretched mesh] near the stake. The pocket had 3 sides, a floor and a wing, and was supported by six wooden stakes and floats on the top line.

As the remainder of the net was bunted, the wing of the pocket was walked along the inside of the bunt. Eventually the wing was pulled into the pocket and the fourth side of the pocket (which is leaded) was raised, completing the square pocket. No rays were captured in this haul.

Our fifth set was made on August 25 with Mr. Steve Kellum of Maryus, Va. Several rays were sighted near the surface after cruising the Guinea Marshes for 1.5 hrs. One end of the net was anchored in about 5 ft (1.5 m) of water and a J-shape set made. Kellum then pulled the leading end of the net past the anchored end. A circular bunt about 20-30 ft (6.1-9.1 m) was formed. No rays were captured in this haul.

The sixth set was made on August 29 at Claybank on the York River using a 19 ft VIMS fiberglass outboard and an aluminum skiff as the net boat. A large concentration of feeding rays had been reported in the area several days earlier. The net was set from the shoreline in a large arc. The leading end of the net was anchored and the net allowed to "bow" with the flooding tide. Several wing tips were seen inside the net after about 1 hr.

We had planned to haul the net onshore on a high slack water. A truck with a 200 ft (61 m) warp line was to be used to haul the net onshore. However, after waiting for a thunderstorm to pass through the area, the ∩-shape net collapsed due to the ebbing tide. The net became entangled and no rays were caught in this haul.

Our final set was made on September 7 at Claybank using a 28 ft VIMS vessel with twin inboard engines. The set was made on a feeding school of rays at high slack water. Water depth was 3-5 ft (1-1.5 m). The procedure was similar to our fifth set. One end of the net was anchored and the set made in a wide circle around the rays. The leading end of the net was then pulled past the anchor and a circular bunt formed. 19 rays were captured in this set. Approximately 20-30 rays were seen to trace the net and escape past the anchored end before the circular set was completed. Body size and wing weight data are shown in Table 1.

Pooled body size and wing weight data for all successful sets are shown in Table 1.

<u>Discussion of Objective I</u>

Chesapeake Bay commercial fishermen use several different methods of haul seining for finfish. Our large mesh haul seine was employed in three basic techniques - hauling the catch to shore, using a separate pocket to bunt the catch, and using one end of the net as the bunt section.

Hauling the catch onshore is recommended as the most efficient method of harvesting cownose rays. Once landed, the catch can be transferred to a vehicle and driven to the processors. This method is presently used by haul seiners along the Va.-N. C. beachfront and a few rigs in Chesapeake Bay. Adequate waterfront sites in Chesapeake Bay for this type of operation however are very limited.

The use of a separate pocket is suggested as the best method of harvesting rays if an onshore haul is not feasible. Rays tend to trace a net and are easily herded into a pocket. Brailing (or bailing) the pocket is accomplished most efficiently using a scoop net overhead line and pulley system and a capstan. As the rays are brailed into the catch boat, the pocket can be bunted further to keep the catch concentrated.

Observations during our previous investigation (Merriner and Smith, in prep.) indicated that feeding schools of cownose rays invade shoal areas during high tide. The angular tips of the ray's pectoral fins breaking the surface and large sediment disturbances are typical signs of the cownose ray feeding behavior. These indicators, however, are only manifest to an observer on the water if there is little or no wave action. Three of our sets which occurred when no rays were sighted in a suspect shoal area demonstrate the futility of "blind" hauls for cownose rays.

Otwell's (1978) set on a large school of cownose in North Carolina in April underscored the value of an aerial observer in locating schools of rays. Cruising schools of R. bonasus when viewed from the air form tight, compact configurations. Often, we observed solid wedge-shaped formations. Feeding schools are characterized by large sediment disturbances in shallow water. A well-defined cloud of sediments can be seen at the head of the disturbance with a plume of dispersed sediment downriver (see Orth 1976). While on the water we experienced considerable difficulty in locating feeding schools of rays. We suggest that a spotter plane would be invaluable to a developing ray fishery. Perhaps, coordination with the menhaden fishery's aerial spotters could be established.

Prior to this investigation, our aerial and commercial catch observations indicated that schools of cownose rays in Chesapeake Bay usually contain no greater than several to several hundred individuals. On the other hand, Virginia and North Carolina haul seine fishermen have related reports of immense schools of rays migrating north along the coast in the spring; however, these events were never authenticated.

On April 19, 1978 Otwell (1978) documented the arrival of a massive school of R. bonasus in Core Sound near Beaufort, N. C. He also demostrated that these large schools could be harvested with existing commercial gears, that is, a small mesh haul seine. His catch contained approximately 10,000 pounds of ray which were "cut out" of a larger school estimated to contain approximately 60-75,000 pounds of ray.

The results of our study further reflect the tendancy of massive, spring schools of *R. bonasus* to fragment upon entry into Chesapeake Bay. Our most successful haul contained about 100 adult rays (estimated total weight ca. 3,000-3,500 lbs). Other successful sets contained 9 (ca. 250 lbs) and 19 (ca. 600-700 lbs) rays, respectively. That smaller schools of *R. bonasus* are found in the Bay during the summer months agrees with the work of Springer (1967), who noted that in other elasmobranch populations, the tendancy to form large groups is stronger during migration than at the terminal ends of the migratory route.

Clearly, availability problems would beset a potential cownose ray fishery. Massive schools can be harvested in North Carolina waters during the spring. Greater effort would be required to fish the smaller schools in Chesapeake Bay. Moreover, *R. bonasus* is not available in inshore waters November through March.

Otwell (1978) indicated that present trends in Europe are conducive for increased importation of skate and ray. As foreign markets would probably require large quantities of ray wings from steady, reliable sources, it is suggested that the cownose ray may be better suited for promotion in a smaller, less-demanding, domestic market.

Otwell's (1978) study demonstrated the efficiency of existing haul seine gears in harvesting cownose rays. The barrel-shaped floats on our net frequently became entangled in the large meshes. Considerable difficulty was encountered while transferring the net from a vehicle to a net boat. Perhaps, with fewer, but larger bullet shaped floats, frequent tangles could have been avoided.

It is suggested that existing small mesh haul seines are sufficient for the harvest of cownose rays. Our large mesh seine caught almost exclusively adult rays with little or no by-catch. During the summer months jellyfish are extremely abundant in Chesapeake Bay. Several of the contracted fishermen noted that this often prevents them from fishing their small mesh seines. A large mesh net may be required to avoid a large by-catch of jellyfish.

Due to the lack of onshore processing facilities available to us, ray wings were separated from the ray body manually onboard the catch boat. We obtained a 33% yield of marketable ray meat. This is somewhat lower than the 42% yield reported by Otwell (1978). It is assumed that the actual yield value lies closer to the latter figure. We suggest that the use of a band saw would greatly aid the onshore processing of ray wings.

Results of Objective II

Skates or rays are usually marketed as "wings or saddles" (=pectoral fins) (Otwell and Crow 1977). Total marketable yield of the cownose ray is approximately 30-40% of its total weight. Disposal of the body portion would present serious problems. Since a potential ray fishery should seek to maximize utilization of the entire ray, we explored several alternatives to ray disposal and also possible by-products.

The bat ray, Myliobatis californica, has menaced the California oyster industry (Barrett 1963). Most oyster grounds are planted in the intertidal zone and are protected by wooden stake fences. One northern California oyster grower fishes directly for the bat ray with fish traps and purse seines (Mr. F. M. Douglas, Humbolt Bay, Calif., personal communication). Presently, rays are disposed of at a local rendering and tallow company.

Only two rendering plants are located in the Tidewater, Virginia area (Murro Chemical Co. and Norfolk Tallow Co., Inc.). Both companies reported that they do not accept fish in their processes. They suggested contact be made with menhaden reduction plants.

Standard Products and Zapata-Haynie, Corp., both of Reedville, Virginia, were contacted concerning the use of ray frames in their reduction processes. Mr. Jim Hardin of Standard Products claimed that large quantities of ray would not be amenable to their operation. He noted that the high collagen content of elasmobranch fishes creates problems in the reduction process. The body fluids of elasmobranchs also contain large amounts of non-protein nitrogen in the form of urea (Smith 1931). Since a majority of the reduced fish meal is used by the poultry industry and the fowl gut cannot digest urea, Hardin suggested that large amounts of ray could sacrifice the quality of the final product.

Representatives of Zapata-Haynie Corporation's research development section indicated that moderate amounts of ray frames would probably not impair their end product. Grinding or chopping the ray frames would not be necessary. Zapata-Haynie presently accepts teleost frames from filleting operations into their process. It should be noted that cattle (Marshall et al. 1946) and swine (Marshall and Davis 1946) are reported capable of utilizing non-protein nitrogen in their diets.

In discussing the Florida shark fishery, Beaumariage (1968) suggested that the simplest method of waste utilization was to section carcass meat and salt it for crab bait. He reported that "salted shark meat continued to be a productive bait for at least four days, whereas the grouper heads lasted only two days." During the summer of 1976 we conducted a similar experiment using sections of cownose ray meat and frames versus the traditional menhaden as crab pot bait for the blue crab, <u>Callinectes sapidus</u> (unpubl. ms.) with results similar to those of Beaumariage. Menhaden produced greater yields for sets < 24 hours. Both baits produced equal yields for sets > 24

hours. The firmer ray meat did not wash out of the bait well, thus half as much ray meat relative to menhaden was required for the experiment. It is of interest to note that during 1978 the "National Fisherman" carried an advertisement for a West Coast fisheries supply firm which sells "frozen skate hanging bait for king and tanner crab". The notice claims "skate hanging bait is far superior to other baits including pollack, cod, rockfishes, etc.". Also, Hildebrand and Schroeder (1927) noted that the wings of the butterfly ray (*Gymnura spp.*) were used to a limited extent by the Chesapeake Bay crab fishery.

Ray frames might also be incorporated into a chum for sportfishing. We sectioned four ray frames [ca. 40-50 lbs (18-23 kg)] manually into 2-3 inch (5-8 cm) chunks. These were ground in a meatgrinder attached to a 7.5 hp. electric motor with a gear reduction box. Approximately 10-12 gallons of coarsly ground ray were obtained. Since we were unable to obtain a VIMS vessel for an offshore chumming experiment, we tested the chum in Chesapeake Bay at the York Spit Light. Five gallons of ground ray were diluted with seawater and slowly ladled overboard from an anchored boat. No oil was apparent on the surface of the chum slick. A few small bluefish were caught on the bottom rigs but none were caught on baits drifted in the chum slick. Five gallons of ground ray mixed with 1 gallon of raw menhaden oil were then chummed at a second station about 1 mile distant from the first. The mixture had a pasty consistancy. Oil globules were apparent on the surface of the slick. Several dozen small sandbar sharks (Carcharinus milberti) were caught on bottom rigs, but only a few were caught on baits drifted in the chum slick

These preliminary results suggest that ground ray with the addition of raw menhaden oil has qualities of an excellent chum. The ray provides bulk, while the menhaden oil, the key to a successful chum (E. Loviere, Zapata-Haynie Corporation, pers. comm.), creates an olfactory corridor. Presently, a bucket of chum (usually ground menhaden) sells for about $7.00 (Onorato 1978) while a gallon of raw menhaden oil costs about $0.20. Chum is proposed as a cost effective, expedient use for ray frames in a commercial ray fisher.

Two biological supply houses (Turtox and Carolina Biological Supply) were contacted concerning the use of small ray specimens in the biological supply trade. The first firm reported that only about 30 specimens of preserved rays are sold per year. These are purchased by the firm for about $0.75 each. The second company was not interested at this time in marketing cownose ray-derived products.

Discussion of Objective II

It is suggested that the best method of utilizing discarded ray frames is for use as crab bait or chum. Ray frames could easily be sectioned into small chunks [ca. 3-4 in. (9 cm) square] with a band saw. The meat could be bagged and frozen or salted for use when conventional baits (menhaden) are in short supply.

Ray could also be used as the bulk ingredient in chum for sportfishing. Sectioned frames could be ground, containerized, inexpensive ray menhaden oil added, and then frozen.

A small tourist trade market may exist for cleaned ray jaws or spines. Extraction of oil from ray livers might also be considered as a by-product to be investigated.

Results and Discussion of Objective III

Haul seine gear restrictions in the states of Maryland, Virginia and North Carolina vary considerably. In addition, commercial fishing in the Potomac River is regulated by the Potomac River Fisheries Commission. We foresee no serious obstacles to the development of a ray fishery within existing guidelines.

In Maryland, haul seines may not exceed 1800 ft. (549 m) in length. Brail lines of up to 1500 ft. (457 m) and 750 ft. (229 m) may be used in Chesapeake Bay and the rivers systems, respectively. Depth of the net may not exceed 15 ft. (4.6 m) although the bunt section may grade to a depth of 22 ft. (6.7 m). Minimum stretch mesh size is 1-1/2 inches (3.8 cm). The seine may not be hauled with more than one power vessel, nor may the catch be emptied onshore.

The Potomac River Fisheries Commission's minimum stretch mesh size for haul seines is 1-1/2 inches (3.8 cm). There is no restriction on maximum mesh size. Maximum seine length with brails shall not exceed 2400 ft. (732 m). Dragging the net with two power vessels is prohibited. Power winches for hauling the net are permitted for use in less than 4 ft. (1.2 m) of water. Catches may be hauled to shore.

The Code of Virginia defines haul seine as any net set out from shore or shallow water [= water not exceeding 8 ft. (2.4 m) in depth at mean low water]. Haul seines must have one and the same end stationary at all times during the seining operation. The stationary end may be changed while the seine is being closed. Haul seines in Virginia shall not exceed 1000 yards (914 m) in length. Those greater than 200 yards (61 m) in length must not have a stretch mesh size less than 3 inches (7.6 cm). There is not maximum mesh size regulation.

The haul seine or long haul fishery of North Carolina is essentially unrestricted as far as gear requirements are concerned. There is no restriction on the length of the seine. Long haul nets may be pulled by two power vessels.

In all states noted above, areas closed to haul seine fishing exist, but are too numerous to list herein. Two areas of note would be important to a potential ray fishery. The Code of Virginia, Section 28.1-81, states that it is unlawful to use a haul seine within 100 yards (91.4) of mean, low-water mark, or three feet of water, in depth at mean low water, whichever is closer to shore, or over any oyster ground held under lease from the Commonwealth, in the Rappahannock River or its tributaries east of the Downing Bridge at Tappahannock. The restriction is exempt if consent of the adjacent landowner has been obtained. As harvesting of rays would be beneficial to Rappahannock River oyster growers, land or leaseowner's permission to fish in an area noted above does not appear to be a major obstacle, once a haul seiner's intent is made known.

North Carolina fishery regulation .0411 excludes nets from being towed or pulled by more than one boat in the Cape Lookout Bight. This area is defined as south of Shackleford Banks which is east of a line which begins at the navigation aid (buoy or beacon) at the western end of the Cape Lookout westernmost jetty and running thence N 06°45'E degrees (M) to the Harkers Island water tower. This regulation clearly restricts long hauling (seine pulled or towed by two vessels) in the above area. However, since rays can effectively be harvested with one end of a haul seine stationary, this restriction does not appear to be a serious impediment to a ray fishery.

Literature Cited

Alverson, D. L. and M. E. Stansby. 1963. The spiny dogfish (Squalus acanthias) in the northeastern Pacific. U.S. Fish and Wildl. Serv., SSR Fish. No. 447. 25 p.

Barrett, E. M. 1963. The California oyster industry. Calif. Dept. Fish and Game, Fish. Bull. 123:18-19.

Beaumariage, D. S. 1968. Commercial shark fishing and processing in Florida. Fla. Bd. Conserv., Ed. Serv. No. 16. 21 p.

Commonwealth of Massachusetts. 1964. Special report of the Department of Natural Resources relative to the control and eradication of dogfish. House No. 3703:104-117.

Hildebrand, S. F. and W. C. Schroeder. 1927. Fishes of Chesapeake Bay. U.S. Bur. Fish., Bull. 43:68.

Marshall, S. P. and G. K. Davis. 1946. The value of shark meal in swine rations. J. Anim. Sci. 5(2):211-218.

Marshall, S. P., R. B. Becker, and G. K. Davis. 1946. Shark meal as a protein supplement in dairy calf rations. J. Dairy Sci., XXIX(2):801-808.

Merriner, J. V. and J. W. Smith. In preparation. A report to Sea Grant on the biology and management of the cownose ray, Rhinoptera bonasus, in Chesapeake Bay.

Onorato, R. 1978. Chumming bluefish. In: The Long Island Fisherman 13(35):14-15, 26.

Orth, R. J. 1975. Destruction of eel grass, Zostera marina, by the cownose ray, Rhinoptera bonasus, in the Chesapeake Bay. Chesapeake Sci. 16(3):205-208.

Orth, R. J. 1976. The demise and recovery of eel grass, Zostera marina, in the Chesapeake Bay, Virginia. Aquatic Bot. 2:141-159.

Otwell, W. S. 1978. Utilization of North Carolina skates and rays. A final report to the Sea Grant Mini-Grant Program. UNC, Morehead City, NC.

Smith, H. M. 1931. The absorption and excretion of water and salts by the elasmobranch fishes II. Marine elasmobranchs. Am. J. Physiol. 98:296-310.

Springer, S. 1967. Social organization of shark populations. In: Sharks, skates, and rays. (Gilbert, Mathewson, and Rall, eds.), The Johns Hopkins Press, Balt. MD.

APPENDIX

Industry Contacts

Lewis Bristow	Capital City Seafood	Washington, DC
Michael P. Curran	Marketing Designs International	Boston, MA
Maywood Shackelford	York River Seafood	
Al Smith	(Haul Seiner)	Perrin, VA
James Hardin	Standard Products	Reedville, VA
Earl Loviere	Zapata-Haynie Corp.	Reedville, VA
George Washington		Whitestone, VA
Mr. Bossi	Geo. Robberecht	Montross, VA
Morris Owens	(Haul Seiner)	Wicomico, VA
Warren Slaughter	Huff & Puff Catfood	Reedville, VA
Robert Miller	Barbary Coast Seafood	Eureka, CA
Mike Tourault	Fass Bros.	Hampton, VA
Buddy Ponton	Beach Haul Seiner	Corolla, NC
George Ross	Pound netter	Lynnhaven, VA
F. T. Jett	Pound netter	Ophelia, VA
Belanga Fish Co.	Beach Haul Seiner	Sandbridge, VA
Alton Hudgins	Pound netter	Hampton, VA
Charlie Conklin	Haul Seiner	Mt. Holly, VA
Edgerton Fish Co.		Cape Charles, VA

Food Technology and Researcher Contacts

Dr. W. Steven Otwell	FSU	Gainesville, FL
Dr. Tyree Lanier	NCSU Seafood Lab	Morehead City, NC
Mr. Gene Skipper Crow	ECU - Sea Grant	Morehead City, NC
Mr. Don Taphorn	Universidad Del Zulia	Maracaibo, Venzuela
Dr. Sam Thomas	NCSU Seafood Lab	Morehead City, NC
Mr. Ed Smith	NMFS Intn'l Trade Specialist	Pascagoula, MS
Dr. George Flick & Frank Huang	VPI-SU	Blacksburg, VA
Dr. Charles Manooch	NMFS	Beaufort, NC
Mr. Roy Scott	MD DNR	Annapolis, MD

Media Contacts

Mr. Eric Mitchell	WGH Radio	Hampton, VA
Ms. Louis Mahoney	Richmond Newsleader	Richmond, VA
Ms. Yolanda Jones	Daily Press	Newport News, VA
Mr. Angus Phillips	Washington Post	Washington, DC
Mr. Frank Woolner	Saltwater Sportsman	Boston, MA
Mr. Dave Dressel	MD BowHunters Soc.	Bethesda, MD
Mr. Dave Ennis	Times Herald	Newport News, VA

*Contacts continue heavily since release of advisory.

BIOLOGY OF COWNOSE RAY, RHINOPTERA BONASUS, IN CHESAPEAKE BAY: FISHERY FOR DEVELOPMENT

Joseph W. Smith and John V. Merriner

Virginia Institute of Marine Science
and
School of Marine Science
College of William and Mary
Gloucester Point, Virginia 23062
804 642-2111

Recent (1972-1977) cownose ray predation on commercially important shellfish beds in Chesapeake Bay induced several oyster growers to solicit and in the form of control measures to reduce the ray population. During the summers of 1976 and 1977, we studied the biology of the cownose ray in lower Chesapeake Bay using samples acquired primarily from commercial fishermen.

Large schools of *Rhinoptera* enter Chesapeake Bay in early May via the sounds and coastline of North Carolina. They reside in the Bay and its tributaries throughout the summer months and leave the area by mid-October. The southward migration in the fall does not appear to be as closely associated with the shoreline as the northward movement in spring.

During the spring gravid females bear three-quarter term young. Parturition occurs in the Bay between mid-June and mid-July. The gestation of another brood of young begins by late July. Only one embryo per gravid female has been observed. As with some shark population, *R. bonasus* exhibit schooling by sex and size.

Feeding schools exhibit a shoalward, nearshore movement with the rising tide. Ray depredations on oyster and hard clam beds are discussed and related to general food habits. Physical deterrents to ray predation are suggested.

Extensive sampling with commercial fishermen and recent fishing gear experiments suggest feasible commercial utilization if processing and marketing are developed.

Paper Presented At:

The 23rd Annual
ATLANTIC FISHERIES TECHNOLOGICAL CONFERENCE
November 5, 6, 7 & 8, 1978
Colonial Williamsburg, Virginia