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A Comparison of Paralichthid Flounder Size–Structure in Northwest Florida Based on Trammel Net Catches Adjusted for Mesh Selectivity and Collection by SCUBA Divers

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By applying a selectivity model for trammel net catches of Gulf flounder, we found that the resulting adjusted length distribution was similar to the offshore diver-sampled length distribution. We found two dominant size modes that seem to be consistent inshore and offshore, a lower mode composed of males and females and an upper mode composed exclusively of females. Southern flounder demonstrated a lower mode of males and small females but also showed larger females and possibly multiple-size modes after trammel net captures were adjusted for size selectivity. The two species showed very similar values for θ_1 (θ_1 = 76.2–79.2), a coefficient affecting the mode of the gamma function used for selectivity. Our findings support the idea that the initial approximation of the mesh selectivities may be simple and could be based on parameters determined from related species. Gulf flounder were more abundant in the trammel net catch than were southern flounder, and Gulf flounder comprised 80% of the net catches but was the only paralichthid flounder we collected offshore. Because southern flounder have been reported offshore from similar depths and habitats along the southeastern U.S. coast, partitioning of spawning habitat may be occurring in our area.

Unbiased data on age, sex, and size composition of fish populations are of great importance for management of fisheries. Most methods of estimating these parameters for a fish species require samples that are representative of the population or representative by area for a specified component (e.g., the adult component) (Gunderson, 1993). Only if size selectivity of the fishing gear is known with respect to the structure of the population, can the catch statistics be adjusted and used to provide correct estimates of the parameters of interest (Hamley, 1975; Millar and Fryer, 1999). Almost always, it is impractical to determine selectivity directly because there remain many technological limits to detecting fish. As a result, investigators often rely on indirect methods of estimating selectivity using multiple gears or gear sizes. The value of these indirect methods, however, is often dependent on ancillary information about fish behavior and population structure (Hamley, 1975; Millar and Fryer, 1999). Therefore, it may be a common error to treat samples as representative (e.g., for mortality estimation) when adequate information on population structure is lacking.

Some fish species are more problematic than others with regard to assumptions about population structure, and paralichthid flounder may be classic examples. Some of the common and economically important paralichthids in the United States are difficult to distinguish from each other, often overlapping in range as they undergo broad ontogenetic habitat shifts from shallow estuaries to largely undocumented depths offshore. Although externally indistinct by sex, these species show high individual variance in growth, together with a strong sexually dimorphic growth pattern (Szedlmayer et al., 1992; Fitzhugh et al., 1996). Also, they may exhibit migrations (e.g., for spawning) that are structured by sex and size (Stokes, 1977; Gilbert, 1986; Murphy et al., 1994).

The economically important co-occurring paralichthids in the Gulf of Mexico include Gulf and southern flounder, *Paralichthys albigutta* and *P. lethostigma,* respectively. In Florida, Gulf flounder dominate the harvest, and St. Andrew Bay, our locality, may be the principal nursery area for Gulf flounder within the Gulf of Mexico (see National Oceanic and Atmospheric Administration, 2000: table 15). Southern flounder dominate the harvest in the remainder of U.S. southeastern and Gulf states (Murphy et al., 1994; Nelson and Monaco, 2000).

Because of their importance and potential difficulty to assess using fishery-dependent sampling alone, we characterized and compared size–structure using methods that would be useful but that have not been commonly applied in fishery-independent surveys. Specifically, our objectives were to determine trammel net selectivity, based on catches made within St. Andrew Bay, and sample flounder from

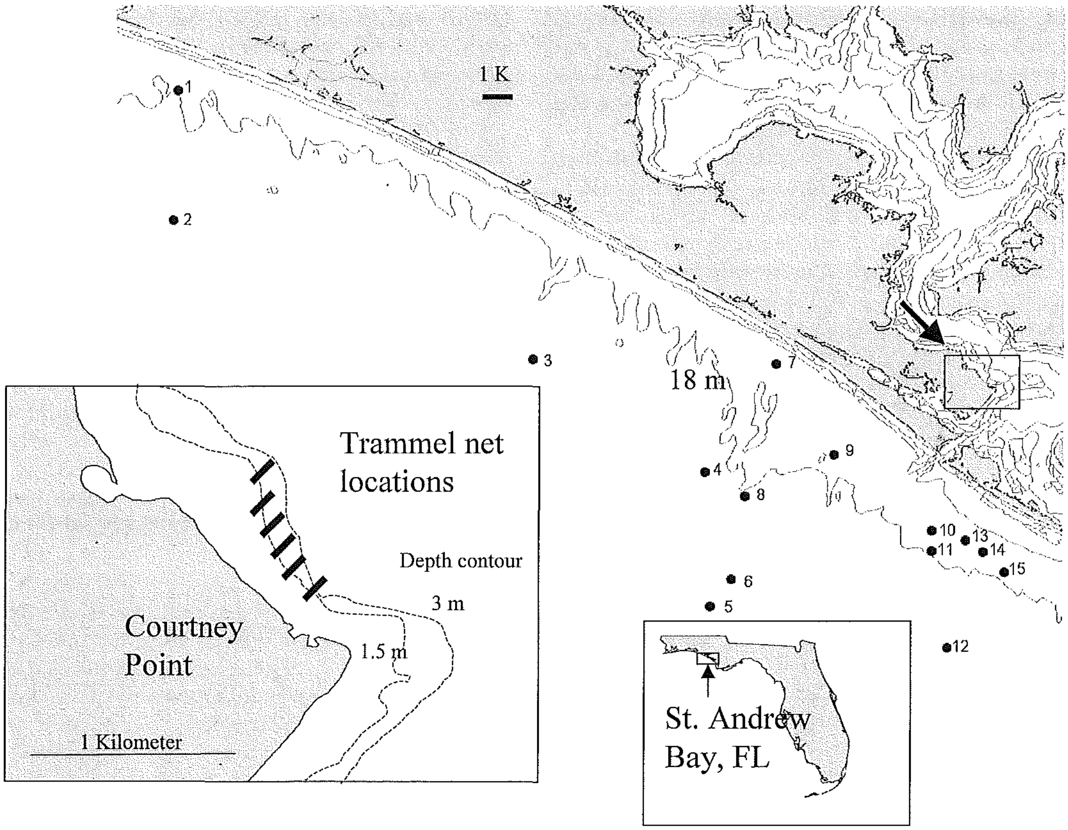

Fig. 1. Study area in northwest Florida showing net locations in the trammel net sampling area (see inset box) and numbered dive locations (see Table 3 for coordinates and catch summary).

offshore waters using self-contained underwater breathing apparatus (SCUBA), and to compare population size–structure from the two approaches. Our fishery-independent sampling was designed to take advantage of a fall-to-winter spawning migration by flounder.

Materials and Methods

Trammel net sampling.—The study area was in the St. Andrew Bay system, located in northwest Florida along the Gulf of Mexico (Fig. 1). During the study, the bay system exchanged water with the Gulf of Mexico through one deep (12–15 m) pass to the Gulf, although historically a second pass has been open. This bay system, when compared with most northern Gulf estuarine systems, is deep and has high salinities, low freshwater inflows, large areas of submerged marine grasses, low turbidities, high percentages of sand in the substrate, and fish and crustacean faunas typical of both coastal and estuarine areas. The mean diurnal range of the tide in the St. Andrew Bay system is 0.4 m.

Information on the capture properties of entanglement nets on Gulf and southern flounder is limited to that reported by Trent and Pristas (1977) on gill net selectivity and Trent (unpubl. data), who monitored a commercial trammel net fishery during 1979–84 in St. Andrew Bay. In these studies, selectivities for flounder were not determined because equal and simultaneous effort was not maintained for each mesh size. Data were, however, useful for approximating size distributions and for determining the mesh sizes to be used in this study.

Six trammel nets, each of a different bunt (inner wall) mesh size, were fished simultaneously during the fall and winter months in an area northwest of Courtney Point during 1996–98 (Fig. 1). Water depth (mean low tide) at each station ranged between 1.3 and 4.2 m. For each sampling period (1–5 d), nets were set at 1200 ± 2 hr and fished or pulled during the same time of the following day(s). Nets were anchored about 125 m apart, parallel to each other and perpendicular to shore. Nets of the various mesh sizes were randomized among locations (Fig. 1) each time the nets were set. Net damage to bunts in the nets was maintained below 5% of the total surface area of the outside (wall) webbing.

General attributes, description, and techniques for fishing trammel nets can be found in Garner (1962) and Hubert (1983), but construction can vary. All trammel nets were 91.4 m long, had monofilament outer-wall webbing 3 meshes deep, with 35.6-cm stretched mesh and a twine size #346 (0.66-mm strand diameter), and had bunt mesh sizes ranging from 8.9 to 16.5 cm (4, 4.5, 5, 5.5, 6, and 6.5 inches). The bunt webbings used were #208 (0.52-mm strand diameter). The mesh in the bunts of the nets was sewn such that the stretch distance of the wall webbing was about 75% of the stretched distance of the bunt webbing. The net frames were constructed using 0.63-cm-diameter hollow-braid polyethylene ropes, polyvinyl chloride floats, and insert leads. Both wall and bunt webbings were hung on the half basis (two lengths of stretched mesh to one length of float line). About 10 kg of lead inserts were used per net. The ratio of floats to leads was such that weight was about double the floatation; each net sank and remained on the bottom if set in water deeper than the hung depth of the net. The nets were held in position by bridal lines attached to anchors and were fished (fish and other animals and plants removed and nets untangled) after each 24-hr period that the nets were set. Total lengths (TL) of fish were determined to the nearest millimeter.

SCUBA collections.—We sampled Gulf flounder from offshore waters by diving with SCUBA and using punch poles to collect the fish. We concentrated our sampling about the 18-m-deep contour in proximity to the St. Andrew Pass, (Fig. 1) where flounder are known by divers to congregate throughout the fall and early winter months, presumably as they exit the Bay to spawn (W. Jenkins, pers. comm.). The punch poles were steel shafts of 0.8–1 m in length with a nylon stringer attached to one end. After fish were impaled, they were slid up the shaft and onto the stringer so that numerous fish could be carried while the diver continued to search. This method is generally used by sport and commercial divers alike in northwest Florida waters. This technique of gigging flounder underwater is efficient and allows access to all sizes within a locality when the fish are located in aggregations. A similar method of shoreline gigging was described by Floyd (1966) and Warlen (1975), but it is unknown whether all fish sizes within a given locality are similarly subject to capture because of restriction to shallow-water sampling.

Gulf flounder were sampled randomly such that they were speared as encountered. If multiple individuals were encountered in a small area, divers were instructed to systematically select flounder to the right to avoid any selection by size or sex. Sometimes two or more flounder overlapped and could be speared at once, and divers took this opportunity if available. Overlapping flounder and flounder in close proximity were commonly found to be a female and a smaller-sized male. However, the spearing of overlapping flounder was infrequent enough for us to believe that this method of sampling did not affect our overall estimate of sex ratio or size distribution of the offshore stock.

Selectivity model.—Several studies have described selectivity of gill or trammel nets or compared the two. A general conclusion is that both gear types result in a continuous probability capture curve with some positive skew to the distribution. The positive skew is generally more pronounced in trammel net selection curves because although many fish are gilled, relatively large fishes can also be snagged or entangled (Koike and Takeuchi, 1985; Losanes et al., 1990). A gamma distribution, which allows for skewed length data, was fit to each mesh size to model selectivity following Kirkwood and Walker (1986) and Simpfendorfer and Unsworth (1998). Using a gamma distribution allowed us to make generalizations about the parameters required to fit the model by comparison with these earlier workers. Mesh selectivities were also calculated following the technique by Kirkwood and Walker (1986), which was recently reviewed and compared with other approaches (Millar and Fryer, 1999; Millar, 2000). Millar (2000) recommended this approach because it enables a simultaneous fit to the catch data by directly using maximum likelihood and overcomes some previous problems related to parameter estimation. The log-likelihood function is

$$L = \sum_{i=1}^{I} \sum_{j=1}^{J} [n_{ij}\ln(\mu_j S_{ij}) - \mu_j S_{ij}]$$

where n_{ij} is the number of flounder of length class j caught in mesh size i,

$$\mu_j = \sum_{j=1}^{I} n_{ij} \bigg/ \sum_{i=1}^{I} S_{ij}$$

TABLE 1. Observed numbers by length class of Gulf flounder caught in trammel nets of six mesh sizes (cm, stretched mesh).

Length class (mm)	Number of Gulf flounder						
	Mesh sizes (cm)						
	10.2	11.4	12.7	14	15.2	16.5	Total
230–249	2						2
250–269	2	1	2				5
270–289	18	2					20
290–309	40	22	1		1		64
310–329	51	46	4	5	1		107
330–349	16	42	14	3	1		76
350–369	12	8	17	4	1	1	43
370–389	13	14	30	21		3	81
390–409	4	12	16	44	13	2	91
410–429	5	4	14	36	9	4	72
430–449	1	5	10	12	14	7	49
450–469	2		1	15	8	13	39
470–489	3	2	2	7	1	1	16
490–509		1	1	2		7	11
510–529	1		1	4	1	4	11
530–549		1	1	2	1	1	6
550+				3			3
Total	170	160	114	158	51	43	696

TABLE 2. Observed numbers by length class of southern flounder caught in trammel nets of six mesh sizes (cm, stretched mesh).

Length class (mm)	Number of southern flounder						
	Mesh sizes (cm)						
	10.2	11.4	12.7	14	15.2	16.5	Total
230–249							
250–269	3						3
270–289	2						2
290–309	8	10	1	1			20
310–329	7	7	6		1		21
330–349	2	3	9	1		2	17
350–369	2		3				5
370–389	1	2	2	2			7
390–409			4	4		2	10
410–429		5		3	4	1	13
430–449	1	4	2	3	5	5	20
450–469				6	5	3	14
470–489					3	2	5
490–509	1	3	5		1	1	11
510–529	1	2	1	1	3	4	12
530–549	4		2		1		7
550+			4		4		8
Total	32	36	39	21	27	20	175

and S_{ij} is the relative selectivity of a flounder of length class j caught in mesh size i. Selectivity can be defined in various ways. Specifically, we are quantifying the contact–selection curve, which is the relative probability that a fish of a given length is retained upon contact with the gear (see Millar and Fryer, 1999). Selectivity is modeled as a function of flounder length class (l_j) and the two parameters describing the probability density function of the gamma distribution (α,β) for mesh size i:

$$S_{ij} = \left(\frac{l_j}{\alpha_i \beta_i}\right)^{\alpha_i} \exp\left(\alpha_i - \frac{l_j}{\beta_i}\right)$$

The values of α and β are calculated from the mesh size (m_i), a scaling parameter (θ_1) to relate the mode of the gamma distribution (α,β) to mesh size, and the variance (θ_2), such that

$$\alpha_i = \theta_1\left(\frac{m_i}{\beta_i}\right) \quad \text{and}$$

$$\beta_i = -0.5[\theta_1 m_i - (\theta_1^2 m_i^2 + 4\theta_2)^{0.5}]$$

The values of θ_1 and θ_2 were obtained by minimizing the negative log-likelihood function using the nonlinear routine SOLVER in Microsoft EXCEL, and examples of programming code and applications are referenced in Millar and Fryer (1999).

There are several assumptions in this indirect method of calculating selectivity, including (1) each mesh size has equal fishing power, (2) the gamma distribution adequately represents the selectivity curves, (3) the nets are fished with equal and simultaneous effort, and (4) for fish in a given length class, the numbers that encounter the trammel net can be said to be distributed as independent Poisson random variables (Kirkwood and Walker, 1986). Deviance residuals were calculated and plotted to examine the model fit following Millar and Fryer (1999).

RESULTS

Trammel net samples.—Gulf flounder were much more abundant in the catches (80% of the total) than southern flounder. The numbers of flounder by bunt mesh size ranged from 43 to 170 for Gulf flounder and 20 to 39 for southern flounder (Tables 1 and 2). Mean lengths averaged 170 mm higher for southern than for Gulf flounder (Tables 1 and 2). Shape of the length distributions varied by bunt mesh size for Gulf flounder and were positively skewed to slightly bimodal (11.4 cm), positively skewed (10.2 and 14 cm), approximately normal (12.7 and 15.2 cm), and negatively skewed (16.5 cm). Length distribution shapes were harder to discern for southern flounder because of the lower number of individuals caught, but

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TABLE 3. Summary of dives and locations where Gulf flounder were sampled offshore of Panama City, FL.

Site number	Name	Latitude (°N)[a]	Longitude (°W)	Number of dives	Number of flounder caught	Depth (m)
1	9 Fathom Hole	30.2644	86.0352	3	7	20.7
2	Anchor Reef	30.2132	86.0365	3	3	26.5
3	No. 7	30.1588	85.8936	3	0	22.9
4	PCMI Barge	30.1136	85.8251	4	10	21.9
5	Black Bart	30.0603	85.8229	3	1	25.0
6	Span #14	30.0712	85.8144	6	22	23.8
7	Longbeach Barge	30.1567	85.7973	4	21	15.8
8	Blown-up Barge	30.1042	85.8096	9	46	19.8
9	Stage II	30.1207	85.7741	24	91	18.3
10	Wet & Wild	30.0908	85.7348	6	12	15.2
11	60′ LOS	30.0825	85.7349	18	25	18.3
12	Span #1	30.0442	85.7289	4	9	22.6
13	Bridge Rubble	30.0867	85.7214	5	12	12.8
14	B&B Barge	30.0820	85.7146	2	4	13.7
15	Eastern Barge	30.0739	85.7059	13	11	15.2

[a] Decimal degrees.

there was positive skewing for the smallest mesh sizes similar to that for Gulf flounder. For both species, the largest meshes caught the fewest flounder (e.g., 16.5-cm mesh).

Offshore samples.—Two hundred and seventy-four Gulf flounder were collected with punch poles by diving at 15 offshore sites during this project (Fig. 1; Table 3). The dive sites were chosen from numerous artificial and natural reef areas that reportedly attracted Gulf flounder during the fall and winter months. Only two of the dive sites were natural bottom areas (9 Fathom Hole and Anchor Reef). They yielded only 10 flounder in six dives. The most productive sites were artificial reefs close to and west of the St. Andrew Pass (Stage II, Blown-up Barge, and Longbeach Barge), yielding an average of more than four flounder per dive. Stage II was the site at which most flounder were obtained and most dives were made. It was also the highest relief artificial reef in close proximity to the pass.

October through Jan. proved to be the most productive months to collect Gulf flounder offshore. These are the months when the fish historically aggregate for spawning. Generally, Gulf flounder were found around high-relief artificial reef structures and may have been attracted to the cover and protection provided by the structure and the presence of prey fishes also taking refuge near the structure. All paralichthid flounder taken offshore were Gulf flounder, but another flounder similar in shape but smaller in size, the dusky flounder, *Syacium papillosum,* was commonly encountered.

Selectivity curves.—On the basis of fits to the data in Tables 1 and 2, the selectivity curves also resulted in some skewed patterns, i.e., skew-right in the 10.2-cm mesh and skew-left in the 16.5-cm mesh for both species (Fig. 2). Southern flounder exhibited broader selectivity curves with slightly greater modes than did Gulf flounder, although the trend toward skewing was similar. Applying the maximum likelihood estimation procedure resulted in the following parameter estimates

Gulf flounder:

$$\theta_1 = 76.19 \qquad \theta_2 = 3026, \quad \text{and}$$

southern flounder:

$$\theta_1 = 79.18 \qquad \theta_2 = 9442.$$

Values for θ_1 were very similar for the two species, but the value for the variance θ_2 was much larger for southern flounder. The residual plots did not reveal any obvious lack-of-fit of the selectivity curves for either flounder species using the two-parameter gamma function (Fig. 3). Some possible patterns include positive deviance residuals for larger-sized flounder of both species for the 10.2-cm mesh, positive residuals for larger-sized Gulf flounder retained by the 14-cm mesh, and negative residuals for larger-sized Gulf flounder from the 15.2-cm mesh.

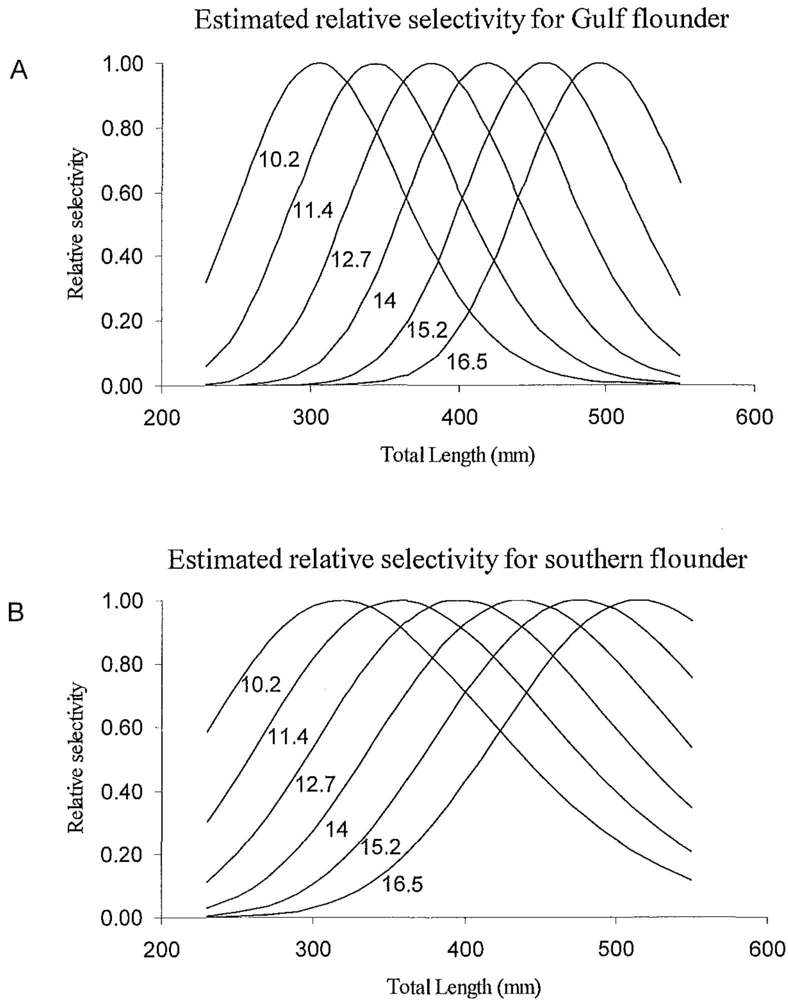

Fig. 2. Estimated relative selectivities as a function of length for (A) Gulf flounder and (B) southern flounder for 10.16-, 11.43-, 12.70-, 13.97-, 15.24-, and 16.51-cm mesh trammel nets (common English measurements: 4.0, 4.5, 5.0, 5.5, 6.0, and 6.5 inches).

Length–frequency distributions compared.—Probabilities resulting from the selectivity curves were used to adjust the inshore length–frequency distributions resulting from summing catches from the 10.2- to 16.5-cm bunt mesh sizes. The ranges in the size of Gulf flounder sampled offshore and inshore were similar (Fig. 4). Average sizes for diver-sampled flounder were 380-mm TL (SD = 65) for females and 312-mm TL (SD = 32) for males. Two size modes were evident, a lower mode consisting of males and small females and a second (upper) mode consisting of larger females. The offshore length–frequency distribution appears to be composed of more larger individuals (males) from the lower mode (300–380 mm) than does the inshore distribution based on the unadjusted Gulf flounder catch from trammel nets (Fig. 4). In general, more males were evident from the offshore collections when compared with the unadjusted trammel net catches. However, the sizes offshore appear to be very consistent with the modes observed from the length–frequency distribution of Gulf flounder captured from the trammel nets when lengths were adjusted for net selectivities and fishing effort. The only difference after adjusting the trammel net catch appears to be that the inshore upper mode of females was at 380 mm, whereas the offshore upper mode was at about 410 mm (Fig. 4).

Although fewer southern flounder were captured in the trammel nets, and they were not found by divers offshore, it was apparent that

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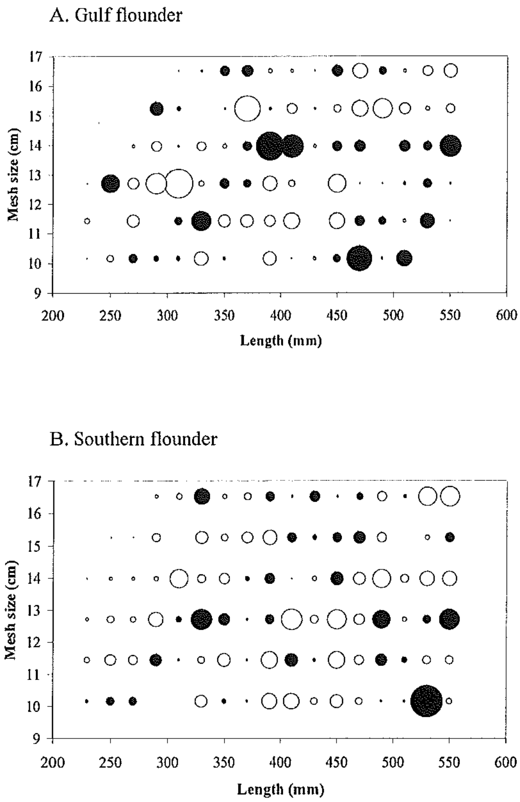

Fig. 3. Deviance residuals for the fits to trammel net data, (A) Gulf flounder and (B) southern flounder. Open and closed circles correspond to negative and positive residuals, respectively, and the area of the circle is proportional to the squared residual.

size–structure was quite different from that of Gulf flounder. There was a small-sized mode composed of males and small females that matched the lower mode observed for Gulf flounder (290–310 mm). But few males greater than 320 mm were caught, and potentially multiple modes of larger females were present (Fig. 5). By proportion, more larger southern flounder were evident (>460 mm) than was observed for Gulf flounder.

Discussion

Although southern and Gulf flounder are morphologically similar and closely related, the two species exhibited different size–structure based on trammel net catches. Both species were typified by a small-sized mode consisting of males and small females and mode(s) of larger-sized females. Male paralichthids have been commonly found to be smaller than females at a given age (Stokes, 1977; Gilbert, 1986). In addition to the smaller-sized mode that included males, Gulf flounder exhibited one mode of large females, with 6% of the adjusted catch larger than 490-mm TL and a maximum observed length of 575-mm TL (2.99 kg). This maximum size exceeds the world record hook-and-line size (2.83 kg; International Game Fish Association, 2000) and indicates that the largest-sized Gulf flounder were susceptible to netting. However, southern flounder showed potentially multiple modes of large females, with 21% of the adjusted catch larger than 490-mm TL and a maximum observed length of 590-mm TL. Southern flounder also were characterized by a higher value of θ_2, which is related to the variance of sizes retained by a mesh size. This supports other findings that southern flounder are generally larger than Gulf flounder, with the largest southern flounder from a research survey reported at just greater than 800-mm TL (see Safrit and Schwartz, 1998). By comparison, Vick (1964) provided a single report of a Gulf flounder greater than 700-mm TL but Gilbert (1986) questioned the observation. Our findings differ from previous results (except Vick's) in that Gulf flounder have not been reported to be very large, typically up to 420–430 mm (Topp and Hoff, 1972; Stokes, 1977); therefore, we found the overall size range, but not the size distributions, to be similar for the two species in our area based on the trammel net catch.

We also observed a difference in the abundance and spatial distribution of the two species. Southern flounder were much less abundant than Gulf flounder and could not be located during offshore dives. From earlier SCUBA surveys in our area, Hastings et al. (1976) similarly found Gulf flounder to be common offshore but did not report sightings of southern flounder. But on the basis of commercial netting, Vick (1964) reports southern flounder to be present in St. Andrew Bay, comprising up to 25% of the commercial catch, an observation that seems to be consistent over time based on our results. Very little information is available regarding the offshore distribution of *Paralichthys* spp. Wenner et al. (1990) reported on the paucity of data concerning distributions of paralichthids offshore in the South Atlantic Bight. They speculated that part of the reason for the lack of southern flounder observations offshore may be the tendency of the species to congregate near structure and therefore be unavailable for trawling. Southern flounder have been collected by divers in spawning condition near artificial reefs and jetties from sand and shell substrates (Safrit and Schwartz,

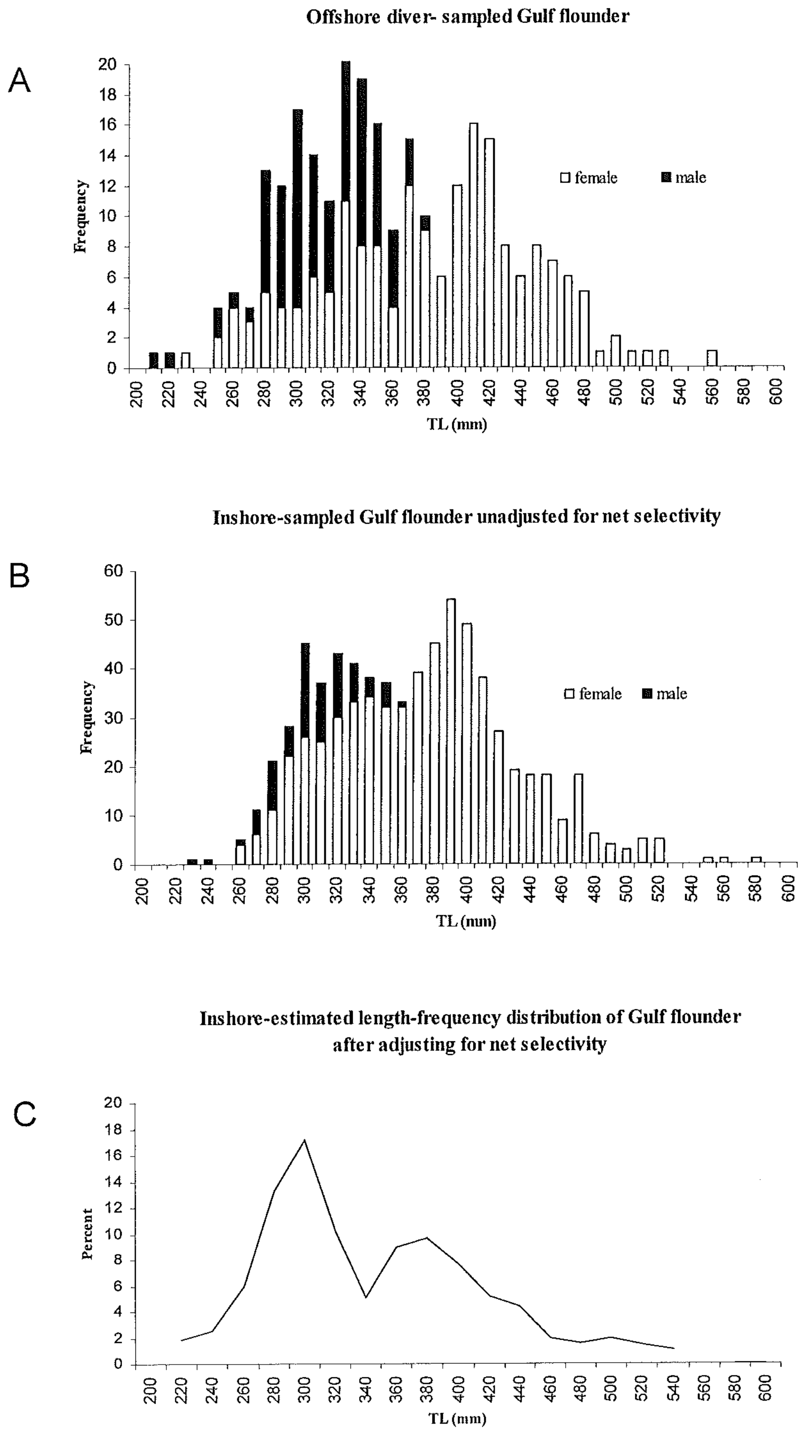

Fig. 4. Length frequencies for Gulf flounder based on (A) diver catch, (B) unadjusted trammel net catch, and (C) trammel net catch adjusted for selectivity.

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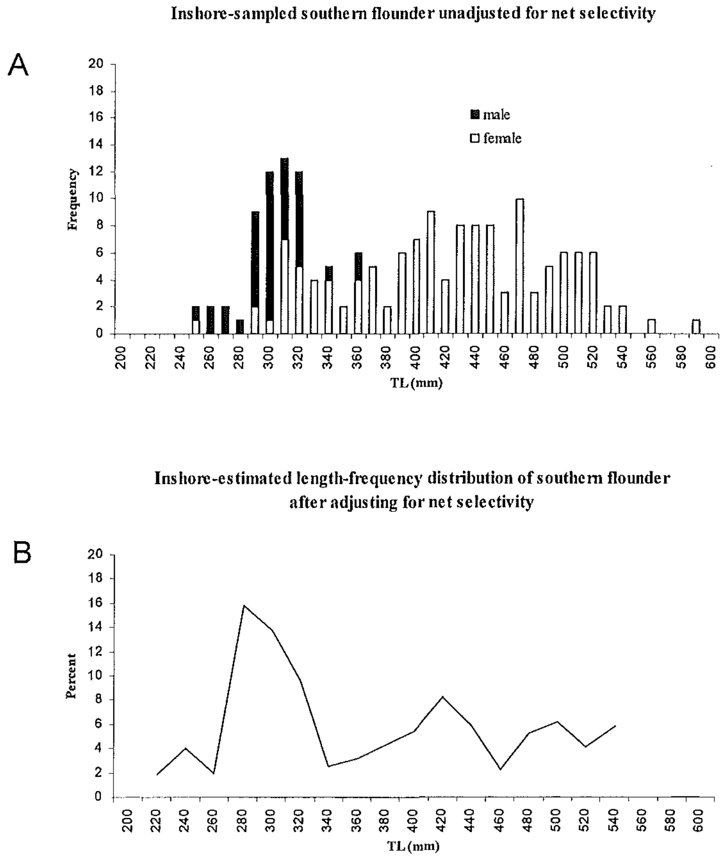

Fig. 5. Length frequencies for southern flounder based on (A) unadjusted trammel net catch and (B) trammel net catch adjusted for selectivity.

1998), but we were unable to locate them from similar habitats. Gulf flounder have been reported from two platforms offshore of Panama City (Hastings et al., 1976), occurring at Stage II (a site we sampled in this study) in all seasons to a varying extent, but were only found from July through Nov. at Stage I, a platform in 33.5 m of water. This observation is consistent with divers' reports that Gulf flounder were less abundant in depths greater than 28 m. Vick (1964) also noted that Gulf flounder were commonly speared by divers at platforms offshore of Panama City. The bottom offshore of Panama City is noted for sandy substrates, limestone ridges, and abundant artificial reefs, and locally these habitats may be avoided by southern flounder during spawning. Gulf flounder clearly have a tendency to aggregate near structure; therefore, partitioning of spawning habitat may be occurring in our area. It is also plausible that southern flounder may be migrating to siltier sediments either to the west or to the east of St. Andrew Bay (Choctawhatchee and Apalachicola estuaries, respectively).

Our characterization of adult paralichthid sizes offshore was dependent on diving conditions and the possible segregation of the population by the depths and bottom types surveyed. Underwater visibility was the most important factor in whether or not flounder could be collected at any given time. Our greatest visibilities occurred during the first year of the project, 1996–97. In the last year of this project, hurricane conditions in the early fall and dredging for a beach renourishment project possibly combined to cause visibilities to be generally much reduced and highly variable. On numerous dives, bottom visibilities were less than 1 m and we immediately returned to the surface. Catch per unit effort was greatly reduced when bottom visibilities were 3 m or less (Fig. 6).

Although size–structure and distribution differences were apparent, the shape and appearance of the two species make them difficult to

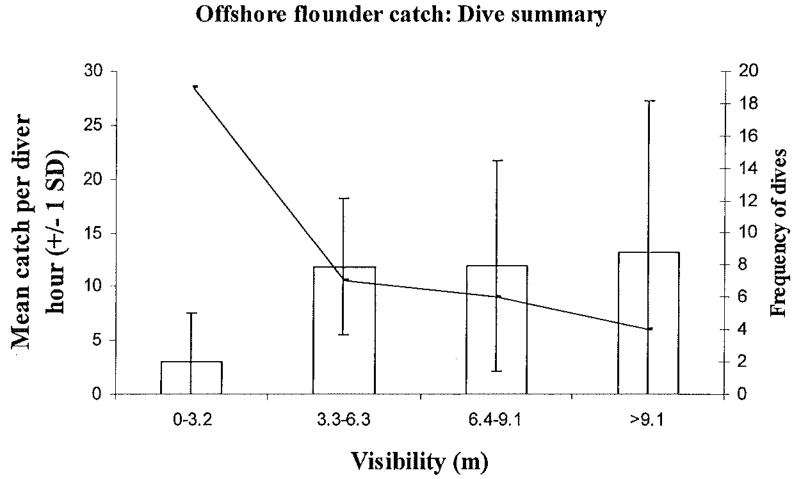

Fig. 6. Mean catch per unit effort and frequency of dives for Gulf flounder sampled from offshore during the period from Aug. to Jan.

distinguish (see Gilbert, 1986). This relatedness may have also been reflected in the value for θ_1, a coefficient affecting the mode of the gamma function used for selectivity, which we found to be very similar for the two species (θ_1 = 76.2–79.2). The value for θ_1 has also been found to be very similar within and between genera of sharks (θ_1 = 124.1–131.6 for *Carcharhinus* spp.; θ_1 = 173.7–184.3 for a *Furgaleus* sp. and a *Mustelus* sp.) and has been hypothesized to be predictable based on taxonomic affinities and resulting from the way in which the animals are retained in the net based on their shape (Simpfendorfer and Unsworth, 1998). Our findings support the idea of Simpfendorfer and Unsworth (1998) that the initial approximation of the mesh selectivities using the gamma function may be simple and could be based on parameters determined from related species.

We realize that other models (i.e., those with more parameters such as the five-parameter binormal function) may result in better statistical fits. This has been observed for gill and trammel net data (Millar and Fryer, 1999). But the residuals did not show obvious lack-of-fit patterns, and we believe that the use of the gamma function is valuable because of the taxonomic generalizations and comparisons with earlier works. Also, we realize that although we obtained a reasonable fit for southern flounder, the results of the model fit may be spurious because of the low sample sizes within most of the length and mesh-size combinations (cells). Ideally, at least three fish per cell should be targeted for fitting the selectivity curves (ICES, 1996; Millar and Fryer, 1999). Although we included the southern flounder results for the taxonomic comparison, these results should be considered tentative. The real value of this approach depends on the comparison of fish size–structure in the wild using other means, and for Gulf flounder, we could make this comparison.

It is rare that a fish species exhibits high density and is sedentary enough to be readily sampled by divers (Larocque, 2000). But Gulf flounder fit these criteria when they aggregated to spawn on the inner continental shelf. This allowed us to make comparisons of size–structure observed by two methods of capture, trammel net and SCUBA, although the comparison is not direct because the two capture methods were used in different localities. Smaller nets tended to catch more flounder and tended to show a positively skewed selectivity function. When trammel net catch was adjusted for contact selectivity, the resulting size distributions by both methods were very similar and may indicate that more smaller individuals and males were available inshore than are reflected in the unadjusted trammel net catch. Offshore, we were confident that we were not biased against sampling small paralichthids because usually we caught the similarly shaped but small species of flatfish—*Syacium papillosum*. Upon final comparison of the adjusted trammel catch and diver catch, both gears showed that abundance of Gulf flounder from the lower mode (males and females ≤360-mm TL) at about 56% was slightly greater than that from the upper mode. This similarity of size components leads us to expect that we were sampling the same migratory por-

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tion of the population in both localities, inshore and offshore.

Although we were specifically modeling contact selection, our diver–trammel comparison suggests that we have a reasonable estimation of population selection for Gulf flounder (as defined by Millar and Fryer, 1999) using the relatively simple two-parameter gamma function. The assumption that flounder encountered the trammel nets as independent Poisson random variables was a central one. Our expectation that this assumption was met is based on observations that Gulf flounder undergo fall-to-winter emigrations from estuaries associated with spawning (Stokes, 1977; Gilbert, 1986), and those individuals in the lower reaches of the bay system and in the proximity of tidal passes should be equally subject to capture. But it may be difficult to determine if the population is spatially segregated at other times of the year. For example, during Feb. and March each year, we noticed a decline in relative abundance of Gulf flounder detected by divers that seemed to be unrelated to visibility or our ability to sample. We can only speculate that flounder dispersed from the hard-bottom habitats and artificial reefs to seek food or temperature refuge (or both). If flounder were migrating inshore, we did not detect them because trammel net catch rates also were low during this period. However, we did not sample the channels and deeper areas of the bay system.

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