Stomach content analysis of cobia, *Rachycentron canadum*, from lower Chesapeake Bay*

Michael D. Arendt
School of Marine Science
College of William and Mary
Virginia Institute of Marine Science
Gloucester Point, Virginia 23062
Present address: Marine Resources Research Institute
South Carolina Department of Natural Resources Division
217 Fort Johnson Road
Charleston, South Carolina 29422-2559
E-mail address: arendtm@mrd.dnr.state.sc.us

John E. Olney
Department of Fisheries Science
School of Marine Science
College of William and Mary
Virginia Institute of Marine science
Gloucester Point, Virginia 23062

Jon A. Lucy
Sea Grant Marine Advisory Program
Virginia Institute of Marine Science
Glooucester Point, Virginia 23062

Cobia (*Rachycentron canadum*) is a migratory pelagic species that is found in tropical and subtropical seas of the world, except in the central and eastern Pacific Ocean. The United States ranks third in total commercial production of cobia, however, recreational landings generally exceed commercial landings by an order of magnitude (Shaffer and Nakamura, 1989). In the western Atlantic Ocean, cobia migrate to Chesapeake Bay in spring and summer to spawn, and the productive waters of the Bay are believed to constitute important foraging grounds (Joseph et al., 1964; Richards, 1967). Cobia are known to move to areas of high food abundance, particularly crustacean abundance (Darracott, 1977).

Recent feeding studies in the northern Gulf of Mexico and off North Carolina have reported geographic differences in cobia diet and have indicated that the relative importance of fishes versus crustaceans is variable and that cephalopods constitute the least significant prey items. In the northern Gulf of Mexico, Franks et al. (1996) reported that fish (primarily anchovies, *Anchoa* sp.) dominated (% index of relative importance [IRI], Pinkas et al., 1971) the diet of juvenile cobia (236–440 mm FL). Meyer and Franks (1996) reported crustaceans (primarily portunid crabs) occurred in 79.1% of stomachs and represented 77.6% of total prey items consumed by cobia (373–1,530 mm FL) in the northern Gulf of Mexico. Fish (primarily hardhead catfish, *Arius felis*, and American eel, *Anguilla rostrata*) increased in importance with increasing cobia size. Fish were found in 58.5% of all cobia stomachs (20.3% of total prey) but occurred in 84.4% of stomachs of cobia 1150–1530 mm FL (Meyer and Franks, 1996). In contrast, Smith (1995) observed decreased importance of teleosts in the diet of cobia (39–142 cm FL) in North Carolina. Elasmobranch fishes and portunid crabs dominated the diet of cobia >9 kg (Smith, 1995).

Tag-recapture data collected between 1995 and 1999 document localized movement of cobia within lower Chesapeake Bay during summer, as well as the return of individual cobia to specific locations or general regions of the lower Bay in subsequent summers.[1] Although Chesapeake Bay is an important destination for migrating cobia, feeding habits of cobia in the Bay have never been thoroughly examined. Our study documents cobia feeding habits in Chesapeake Bay and compares findings with similar cobia studies from North Carolina and the northern Gulf of Mexico.

Methods

Cobia were sampled opportunistically at marinas and fishing tournaments in lower Chesapeake Bay between June and July 1997. Intact stomachs were removed by cutting above the cardiac sphincter (esophagus) and below the pyloric sphincter (large intestine). Stomachs were labeled, bagged, transported on ice to the VA Institute of Marine Science, and examined in relatively fresh condition. An incision was made along the longitudinal axis and the contents of stomachs were emptied onto a 500-µm mesh sieve for rinsing and sorting. Contents were blotted dry on paper towels before counts, displaced volumes (1-L graduated cylinder), and identifications to the lowest possible taxon were made. When possible, carapace widths (mm) of crabs were measured with calipers. An index of relative importance (IRI) for all prey items combined was calculated with the formula (% *Number* + % *Volume*) × (% *Frequency*), as described by Pinkas et al. (1971) and subsequently used by Smith (1995), Meyer and Franks

* Contribution 2390 of the Virginia Institute of Marine Science, Gloucester Point, VA 23062.

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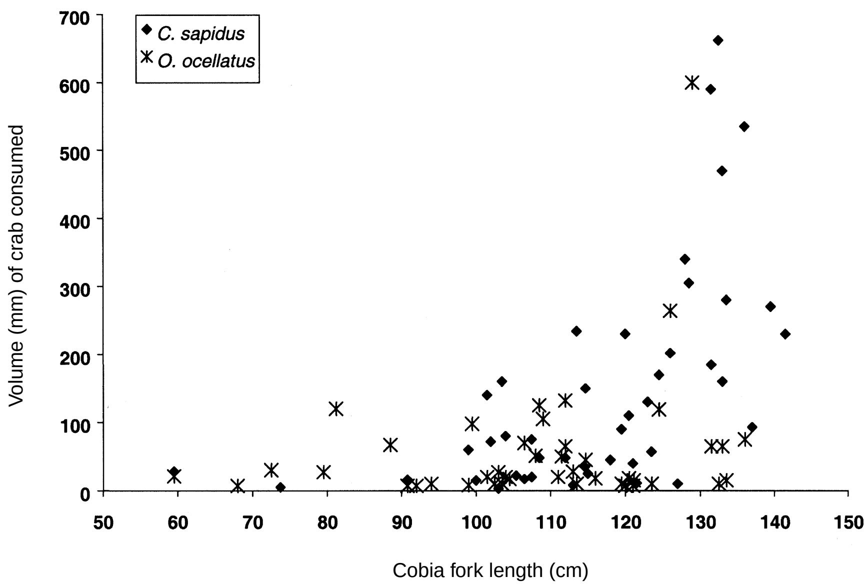

Figure 1

Volume (mL) of portunid crab consumed in lower Chesapeake Bay as a function of cobia size.

(1996), and Franks et al. (1996). Frequency (%*F*) was the percent of all stomachs that contained food.

Results and discussion

Stomach contents from 114 adult cobia (37–141 cm FL) were examined. Seventy-eight stomachs (68%) contained at least one identifiable, nonbait prey item. One species of bivalve, one species of hydroid, six species of crustacean, one elasmobranch, and 16 species of teleost were observed (Table 1). Mean volume of prey per stomach was 150.6 mL (range: 2–680 mL). Mean number of different prey per stomach was 1.9 species (range, 1–5 species). Blue crab (*Callinectes sapidus*) and lady crab (*Ovalipes ocellatus*) dominated the diet of cobia.

Index of relative importance (IRI) values for blue crab (5257) and lady crab (3665) were two orders of magnitude higher than IRI values for other prey items. Larger cobia consumed greater volumes of crab (Fig. 1). Additionally, larger cobia consumed larger (sublegal, <13 cm) blue crabs, although similar-size lady crabs were consumed by all sizes of cobia (Table 2). Atlantic croaker (*Micropogonias undulatus*), hogchoker (*Trinectus maculatus*), and fish and crab remains constituted the top food items volumetrically after portunid crabs. Although relatively high volumes were observed, IRI values for Atlantic croaker and hogchoker were low owing to infrequent occurrence of these items. High volume of crab remains was consistent with high volumes, counts, and frequency of occurrence of portunid crabs in cobia stomachs. Fish remains likely resulted from finfish bait (predominantly menhaden, *Brevoortia tyrannus*, and Atlantic croaker, *Micropogonias undulatus*). Crab and fish remains not identifiable to family and finfish bait were excluded from IRI calculations.

Consumption of blue crab was greatest along the western shore of the Bay and least at the mouth of the Bay. Conversely, consumption of lady crab was greatest at the mouth of the Bay and least along the eastern shore of the Bay (Fig. 2A). A greater percentage of lady crabs were consumed by male cobia than by female cobia, whereas a greater percentage of blue crabs were consumed by female cobia (Fig. 2B). IRIs for blue crab and lady crab were similar in June, but dramatically different in July. In July, IRI for blue crab was twice as high as that for lady crab. Prey availability and habitat utilization were likely responsible for determining location, sex, and within-season differences in composition of portunid crabs consumed by cobia. June samples were predominantly male cobia collected from the Bay mouth and eastern shore of the Bay, whereas July samples were predominantly female cobia collected from the western Bay shore.

Cobia feeding habits in lower Chesapeake Bay were more similar to feeding habits reported for cobia from North Carolina (Smith, 1995) than to feeding habits of cobia from the northern Gulf of Mexico (Franks et al., 1996; Meyer and Franks, 1996). Portunid crabs dominated the diet of cobia in Chesapeake Bay and North Carolina (Smith, 1995). Elasmobranch fishes were consumed exclusively by large cobia in Chesapeake Bay and North Carolina (Smith, 1995). In North Carolina (Smith, 1995), cobia fed on stingrays (*Dasyatis* sp.) and smooth dogfish (*Mustelus canis*). Cownose ray (*Rhinoptera bonasus*), previously unreported as a food item of cobia, was the only elasmobranch consumed by cobia in Chesapeake Bay. Cownose ray was observed from eight cobia stomachs; however, on-

Table 1

Index of relative importance (IRI) of prey items consumed by cobia (*n*=78) in lower Chesapeake Bay, June–July 1997. IRI was calculated as (% *Number* + % *Volume*) × (% *Frequency*), as described in Smith (1995) and Meyer and Franks (1996). Frequency (%*F*) is the percent of stomachs that contained food. UnID = unidentified.

	Frequency (stomachs)	%*F*	Number (counts)	%*N*	Volume (mL)	%*V*	IRI
Phylum Cnidaria							
Class Hydrozoa							
Family Sertulariidae							
Sertularia sp.	1	1.28	1	0.14	8	0.07	0
Phylum Mollusca							
Class Bivalva							
Family Mytilidea							
Mytilus edulis	2	2.56	47	6.60	17	0.14	17
Phylum Arthropoda							
Class Crustacea							
Family Squillidae							
Squilla empusa	2	2.56	2	0.28	11	0.09	1
Family Pagruidae	3	3.85	3	0.42	5	0.04	2
Family Portunidae							
Callinectes sapidus	46	58.97	226	31.74	6736	57.31	5252
Ovalipes ocellatus	43	55.13	321	45.08	2505	21.31	3660
Family Canceridae							
Cancer sp.	2	2.56	2	0.28	26	0.22	1
Cancer irroratus	1	1.28	1	0.14	5	0.04	0
Family Xanthidae							
Neopanope sp.	1	1.28	3	0.42	5	0.04	1
Phylum Chordata							
Class Chonrichthyes							
Family Myliobatidae							
Rhinoptera bonasus	7	8.97	8	1.12	81	0.69	16
Class Osteichthyes							
Family Clupeidae							
Opisthonema oglinum	1	1.28	3	0.42	160	1.36	2
Brevoortia tyrannus	1	1.28	1	0.14	180	1.53	2
UnID Clupeidae	2	2.56	2	0.28	275	2.34	7
Family Batrachoididae							
Opsanus tau	1	1.28	1	0.14	185	1.57	2
Family Ophidiidae							
Ophidion marginatum	1	1.28	1	0.14	42	0.36	1
Ophidion sp.	3	3.85	4	0.56	47	0.40	4
Family Sygnathidae							
Syngnathus floridae	1	1.28	1	0.14	2	0.02	0
Syngnathus sp.	2	2.56	2	0.28	9	0.08	1
Hippocampus erectus	1	1.28	1	0.14	3	0.03	0
Hippocampus sp.	5	6.41	49	6.88	52	0.44	47
Family Pomatomidae							
Pomatomus saltatrix	1	1.28	1	0.14	180	1.53	2
Family Sciaenidae							
Micropogonias undulatus	3	3.85	3	0.42	663	5.64	23
Family Uranoscopidae							

continued

Table 1 (continued)

	Frequency (stomachs)	%*F*	Number (counts)	%*N*	Volume (mL)	%*V*	IRI
Family Uranoscopidae (continued)							
Astroscopus sp.	1	1.28	1	0.14	40	0.34	1
UnID Pleuronectiformes	3	3.85	4	0.56	5	0.04	2
Family Bothidae							
Paralichthyes dentatus	2	2.56	2	0.28	25	0.21	1
Scopthalamus aquosus	1	1.28	1	0.14	15	0.13	0
UnID Bothidae	1	1.28	1	0.14	2	0.02	0
Family Soleidae							
Trinectes maculatus	9	11.54	14	1.97	440	3.74	66
UnID Soleidae	3	3.85	3	0.42	15	0.13	2
Family Diodontidae							
Chilomycterus schoepfi	3	3.85	3	0.42	15	0.13	2
Totals			712				11754

Table 2

Consumption of portunid crabs as a function of five cobia size classes in lower Chesapeake Bay.

	Cobia size class (cm FL)				
	<100	100–109.9	110–119.9	120–129.9	>130
Callinectes sapidus					
n	9	16	12	23	42
Mean carapace width (mm)	55.2	72.3	75.0	116.7	94.7
Range of carapace width (mm)	33–86	42–120	45–120	42–120	35–120
Ovalipes ocellatus					
n	42	37	38	32	27
Mean carapace width (mm)	39.1	41.2	37.7	45.3	37.1
Range of carapace width (mm)	26–50	30–56	20–51	20–51	27–55

ly the jaw plates (22–49 mm width) remained; thus, the IRI for cownose ray is likely underestimated. Flatfishes and syngnathids represented the teleosts most frequently consumed by cobia in Chesapeake Bay and North Carolina. Hogchoker (*Trinectes maculatus*) was more frequently consumed by cobia in Chesapeake Bay (our study) than in North Carolina (Smith, 1995). Blackcheek tonguefish (*Symphurus plaigusa*) was regularly consumed by cobia in North Carolina (Smith, 1995) but was absent from cobia stomachs in Chesapeake Bay. In Chesapeake Bay, *Syngnathus* sp. (pipefish) and *Hippocampus* sp. (seahorse) were only important in the diet of smaller cobia, whereas in North Carolina, these fishes were important in the diet of all cobia (Smith, 1995).

Cobia in our study predominantly consumed benthic and epibenthic prey items, most notably portunid crabs. Feeding studies on other large predatory fishes in Chesapeake Bay during the summer months, such as bluefish, *Pomatomous saltatrix*, and weakfish, *Cynoscion regalis*, reveal that these species consume prey items associated predominantly with pelagic food webs (Hartman and Brandt, 1995a, 1995b). Striped bass, *Morone saxatalis*, a large predator present in Chesapeake Bay year-round, is also reported to feed predominantly on pelagic fishes (Hartman and Brandt, 1995a, 1995b; Walters, 1999). During the summer, portunid crabs were consumed by bluefish, weakfish, and striped bass in Chesapeake Bay; however, portunid crab consumption was typically less than 5% of total prey items present in the stomachs of these fishes (Hartman and Brandt, 1995a, 1995b; Walters, 1999). Red drum, *Sciaenops ocellatus*, a large predator that uses Chesapeake Bay between spring and fall is also reported to selectively consume portunid crabs in estuarine environments in the Gulf of Mexico (Scharf and Schlict, 2000); however, feeding habits of red drum in Chesapeake Bay have not been documented. Although

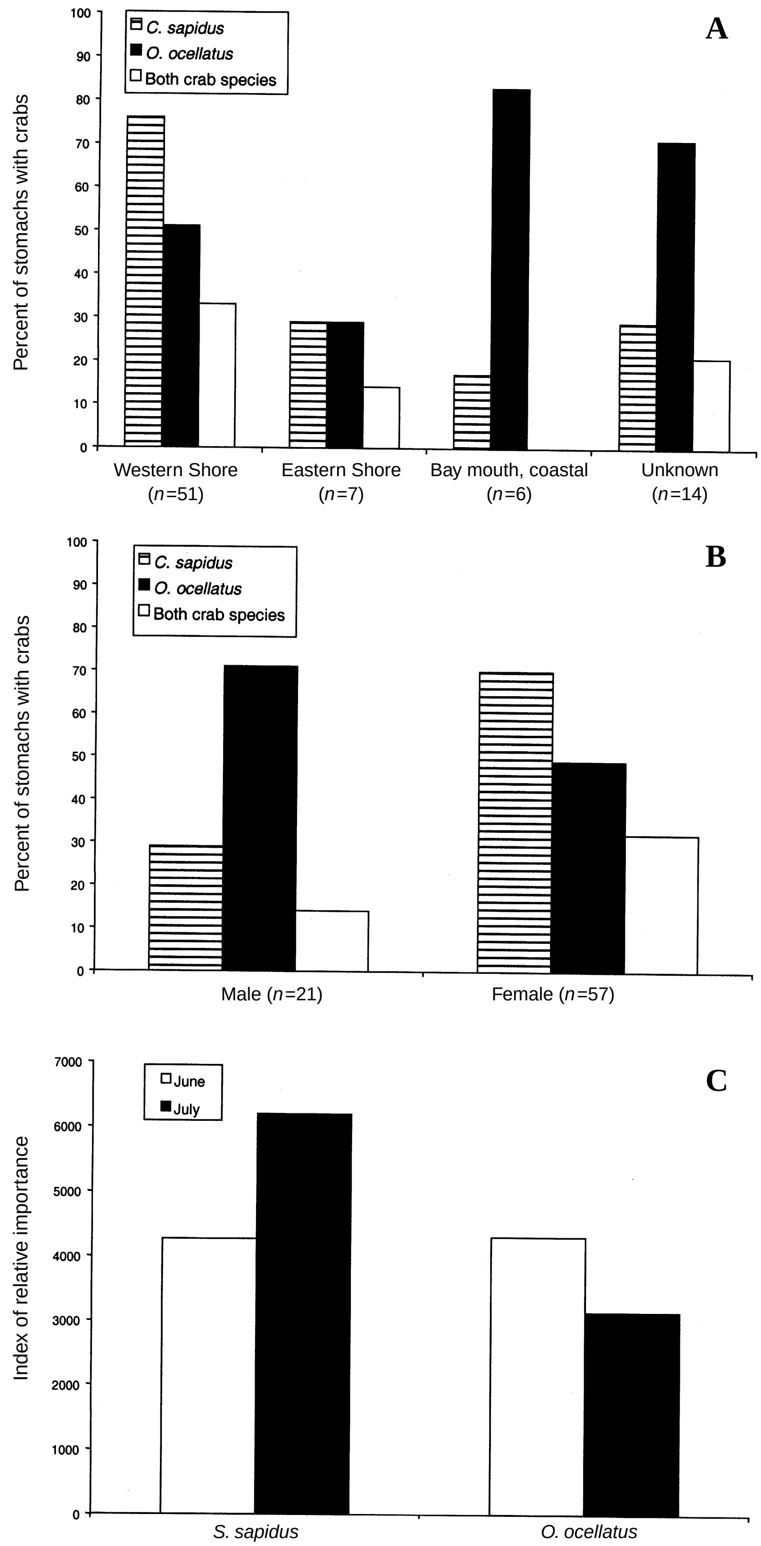

Figure 2

Consumption of blue crab (*Callinectes sapidus*) and lady crab (*Ovalipes ocellatus*) by cobia in lower Chesapeake Bay by location (**A**), sex (**B**), and month (June and July, **C**).

other large predators in Chesapeake Bay occasionally consume portunid crabs, cobia is the only large predator in Chesapeake Bay for which selective consumption of portunid crabs is documented.

Acknowledgments

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