determine the sources of significance in this main effect. Stimuli at 2° yielded significantly ($P < .01$) increased latencies over each of the other visual angles, while both 3° ($P < .01$) and 5° ($P < .05$) presentations were significantly increased over the 10° conditions. Stimuli presented at 15° produced significantly ($P < .05$) longer latencies than those at 10°. A similar bimodal relationship has been hypothesized to support different visual programming systems according to location of targets in visual space [D. Frost and E. Poppel, *Biol. Cybern.* **23**, 39 (1976); F. J. Pirozzolo and K. Rayner, *Neuropsychologia* **18**, 224 (1980)].
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Ureterosigmoidostomy and Colon Carcinogenesis

Although Crissey *et al.* (*1*) have devised a successful model for ureterosigmoidostomy in the rat, we advocate caution in accepting their hypothesis that the resulting anastomotic tumors are caused by urinary enzymes activating fecal procarcinogens. The authors overlooked the tendency for almost any intestinal anastomosis to be a favored site for tumor formation, both in man and experimental animals (*2*). Spontaneous intestinal tumors in rodents are rare (*3*), but we (*4*) encountered one adenocarcinoma at a colonic transection site in a rat receiving no carcinogen, and a similar phenomenon occurred in Crissey *et al.*'s (*1*) experiment. Since some of the intestinal carcinogen employed (dimethylhydrazine) reaches the colonic mucosa through the bloodstream (*5*), the absence of tumors at the suture line after proximal diverting colostomy probably reflects the colonic atrophy of defunction (*6*). Chemical carcinogenesis in the distal colon is reduced, though not abolished, by proximal colostomy (*7*).

We suggest that the development of tumors at sites of intestinal anastomosis is more likely to result from hyperplasia provoked by surgical trauma or the presence of suture material. Indeed, compensatory postresectional hyperplasia, which may be maximal in the immediate vicinity of an anastomosis (*8*), probably accounts for enhanced carcinogenesis after intestinal resection in experimental animals (*2*). In the experiment of Crissey and his colleagues, the specific effect of urinary diversion might have been tested by performing sigmoid colotomy or transection rather than vasectomy as the control operation.

Until some of these etiologic uncertainties are resolved, it is premature to conclude that the use of colon conduits in children is entirely free from the risk of subsequent carcinoma.

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Bristol and Williamson raise a valid question as to the role of a colonic suture line in carcinogenesis. However, we found that neither a sutured colostomy (0/10) nor the anastomosis to the colon of a vascularized patch of bladder without urinary inflow (0/13) had any tumors after 1 year (*1*). These controls clearly could not suffer from "atrophy of defunction." The required presence of urine and feces for tumor formation leads us to our currently favored hypothesis that the obligatory urinary precarcinogens (for example, nitrate) become activated to short-lived proximate carcinogens by fecal bacteria. The phenomenon of suture-line sensitization to carcinogens brought up by Bristol and Williamson may well provide the explanation for the consistent location of the resulting bowel tumors at the suture line.

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Plankton Productivity and the Distribution of Fishes on the Southeastern U.S. Continental Shelf

The report by Turner *et al.* (*1*) is an important contribution to a topic that is becoming increasingly popular (*2*). However, the conclusions in (*1*) could have benefited from additional sources of data which bear significantly on the results. I believe that the winter increase in offshore primary productivity shown in figure 2 of (*1*) is also an important component of nearshore shelf coupling. In the South Atlantic Bight there are generally two periods of annual abundance associated with the spawning of nearshore marine and estuarine species. A summer and early fall peak is associated with the presence of primarily anchovies (Engraulidae) and gobies (Gobiidae). This peak seems to coincide with the one shown in figure 2 of (*1*). As Turner *et al.* suggested, many individual eggs and larvae may have been washed out of local estuaries.

A second peak of seasonal abundance, however, normally occurs in winter and early spring and is coincident with the spawning of spot (*Leiostomus xanthur-*

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Table 1. Peak recruitment months for selected species of larval fishes utilizing the Cape Fear River estuary during 1977 and 1978. Monthly collections were taken from December 1976 through August 1978.

Species	Peak recruitment	
	1977	1978
Leiostomus xanthurus	March–April	March–April
Brevoortia tyrannus	March–April	April–May
Lagodon rhomboides	March	March
Mugil cephalus	March–April	March–April
Micropogonias undulatus	December	
Paralichthys spp.	February–March	March–April

us), menhaden (*Brevoortia* spp.), pinfish (*Lagodon rhomboides*), striped mullet (*Mugil cephalus*), Atlantic croaker (*Micropogonias undulatus*), and flounder (*Paralichthys* spp.). Peak seasonal abundances in 1977 and 1978 for several of these taxa collected in estuarine waters near the Cape Fear River, North Carolina, are shown in Table 1 (*3*, *4*). In each instance, maximum abundance occurs in the estuary in winter and early spring with the source of recruitment occurring from well offshore (*5*). Transit time for individual larvae from these offshore (shelf) spawning grounds is minimally measured in weeks (*6*), and larvae and postlarvae range from about 4 to 22 mm (standard length) upon arrival at the mouth of the estuary. Because little or no spawning for these species is believed to take place in inshore waters (*5*), peak spawn in the ocean probably occurs in midwinter, overlapping the offshore increase in primary productivity shown in figure 2 of (*1*). After yolk absorption, many of these taxa feed primarily on the early life stages of pelagic calanoid copepods (*7*) and must find suitable concentrations of food early to avoid starvation (*8*, *9*). The phenomenon described by Turner *et al.* regarding the winter peak of primary productivity and zooplankton abundance seems to correlate well with the seasonal abundance of winter-spawned larvae and may afford survival value during their initial period of critical feeding (*8*). Of particular interest for future research efforts is the role winter storms play as density-independent regulators of larval fish populations and ultimate year-class success.

Another important factor is the shore-shelf coupling associated with the return (to the ocean) of maturing adults of the species listed in Table 1. Weinstein *et al.* (*3*) have estimated the export of living biomass in the form of migrating fishes and shellfish leaving the Cape Fear estuary each fall to be in the neighborhood of 7 kcal/m^2 (without considerations of gear efficiency or the export of less abundant species). This value may be placed in further perspective when considered in light of a study of Cape Fear marsh productivity conducted by Seneca *et al.* (*10*). In a mesohaline marsh located about 12 km from the river mouth, potential export of dissolved organic carbon and detritus (originating primarily from *Spartina alterniflora*, smooth cordgrass) was estimated at 9377 kcal/m^2. If this material passes through at least three trophic levels (for example, bacteria, amphipods, and secondary consumers) before it becomes available to marine predators, the equivalent yield of energy to higher trophic levels in the marine environment from transient species growing up in the marshes is of the same order of magnitude as that of primary productivity. Thus, there is a direct link by way of the marine-spawned species that utilize estuaries in the early life stages that should not be overlooked when one is considering the phenomenon of estuarine-nearshore shelf coupling.

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In a recent report Turner *et al.* (*1*) concluded that "the gross plankton community dynamics on this shelf [the southeastern U.S. continental shelf] are dominated by couplings with the local estuaries and shallow nearshore zone." According to Turner *et al.* (*1*), coupling exists because the estuaries are the primary source of dissolved plant nutrients or particulate organic matter supporting plankton-based food chains of the southeastern continental shelf. For the past 4 years we and others have studied the interactions between the physical, chemical, and biological regimes of the southeastern continental shelf. Our results are in agreement with those of Turner *et al.* (*1*) for the zone inshore of the 10- to 15-m isobath, which represents only about 20 percent of the surface area and less than 10 percent of the shelf water volume (*2*). However, our results from studies of the shelf offshore of the 20-m isobath contrast sharply with their conclusions (*3*).

Our argument is based on two characteristics of the physical regime of the shelf and their observed effect on the biota. First, owing to freshwater discharge, salinity fronts form within several kilometers of shore and restrict onshore-offshore circulation (*4*). Such fronts are a "dynamic barrier" to mixing and exchange between estuarine and shelf waters. Second, upwelling at the shelf break is a major source of plant nutrients that sustains and enhances biological productivity of the outer and midshelf. Under suitable meteorological and oceanographic conditions, the effects of upwelling at the shelf break are observed as far inshore as the 20-m isobath. Upwelling occurs in response to wavelike motions of the Gulf Stream, which have been referred to as deflections, meanders, or spin-off eddies (*5*). Such features pass a fixed position on the outer shelf an average of once every 2 weeks, and there are indications that they occur more frequently in the spring. Subsurface intrusions of nutrient-rich water move onto the shelf as a result of the circulation associated with these features.

The assertion of Turner *et al.* (*1*) that primary production and the concentration of zooplankton, fish eggs, and fish larvae decrease with increasing distance from shore contradicts the results of other studies of the southeastern shelf. Decreasing offshore concentrations of biological variables are critical to their argument, as they imply that the most significant source of nutrients and particulate organic matter for the southeastern shelf are the estuaries and river discharge. The results of other studies contradict this view and indicate that intrusions of offshore water supply up to 25 percent of the shelfwide phytoplankton requirement for nitrogen (the production-limiting nutrient in the ocean) or about four times that contributed by rivers and estuaries (*6*). Rates of primary production during upwelling on the outer shelf are as high as 6 g of carbon per square meter per day (*7*), a rate equal to maximum values reported for the inner shelf near the outflow of a major river (*8*). Distinct assemblages of oceanic zooplankton are associated with intrusions of Gulf Stream water with high concentrations of copepods reported within subsurface intrusions more than 60 km offshore (*9*). The distribution of fish eggs and larvae suggests that the outer shelf is a breeding ground for many species of fish including the commercially important Atlantic menhaden (*10, 11*), bluefish (*12*), and chub mackerel (*13*). For both the Atlantic menhaden and the bluefish, the outer southeastern shelf is a major spawning area during winter and early spring for the entire East Coast population (*10, 12*).

Our conception of food chain dynamics on the southeastern shelf is considerably different from that proposed by Turner *et al.* (*1*). We agree that the inner shelf is coupled with the estuaries, and that biological production there ultimately depends on river and estuarine nutrient sources. In contrast, the food chain of the outer shelf depends on upwelling to replenish plant nutrients depleted by biological processes or removed by the strong currents that characterize this region. Thus, conditions on the outer southeastern shelf are similar to those north of Cape Hatteras in that offshore sources of nutrients sustain biological productivity (*14*). The implication of our work is that man's activities in the coastal wetlands will have a minimal impact on outer shelf food chains, since the biological response is forced by offshore physical processes rather than by river or estuarine influence. In the case of the southeastern continental shelf, the "subtle couplings of estuary, nearshore, and offshore zones" referred to by Turner *et al.* (*1*, pp. 219–220) should be put into perspective on the basis of available knowledge and not be overemphasized in future research efforts, or by environmental managers, at the expense of ignoring oceanographic processes that dominate the food chain dynamics of the outer shelf.

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Yoder *et al.* have recently concentrated their efforts at the Georgia and South Carolina shelf break, where subsurface intrusions of nutrient-rich waters occur. Yoder *et al.* and I apparently agree about the strong couplings between the estuary and the nearshore zone (*1*). I cannot agree, however, with their conclusion that changes in the plankton community in the area offshore of the 20-m isobath are driven by upwelling events at the shelf break. There are ample data and reports originating from their laboratory to support an alternative interpretation.

Subsurface intrusions, originating at the shelf break, have been observed to penetrate landward across the shelf. However, the average penetration, measured in April, July, September, and December along six transects 100 to 150 km long and normal to the shoreline between Charleston and Jacksonville, is only 19.2 km. The average offshore extent of "estuarine runoff" or "outwelling" was 33.4 km onto the shelf (*2*). There is a greater penetration onto the southern and northern flank of the southeastern U.S. shelf (*3*). Benthic foraminiferal species indicative of intrusions are, therefore, largely absent between land and 80 to 100 km seaward, except at the southern flank (*4*). Thus, 70 percent or more of the shelf is, on the average, free of significant intrusion. In contrast, all of the shelf is subject to the seaward flushing of the nearshore zone.

The use by Yoder *et al.* of the term "dynamic barrier" to describe frontal zones between shallow and deeper shelf waters is unfortunate. Its use here implies that exchange of materials across these zones is prohibited, rather than merely inhibited and, thus, the seaward zone is erroneously perceived as isolated from events in the nearshore area. Fresh water flushing out of the nearshore zone is seaward and not alongshore (*5*) and must therefore carry passively drifting plankton and materials seaward as well; Haines' (*6*) pre- and poststorm shelf sampling for chlorophyll a pigments, particulate carbon, and nutrients also documents the seaward mixing of nearshore waters.

Although Yoder *et al.* claim otherwise, decreasing average offshore concentrations in plankton community indicators are commonly observed, for example, chlorophyll a pigments (*6–8*), total adenylates and adenosine triphosphate (*7*), particulate organic carbon and nitrogen (*6, 9*), primary production rates (*9, 10*), benthic chlorophyll a (*11*), and community plankton metabolism (*12*).

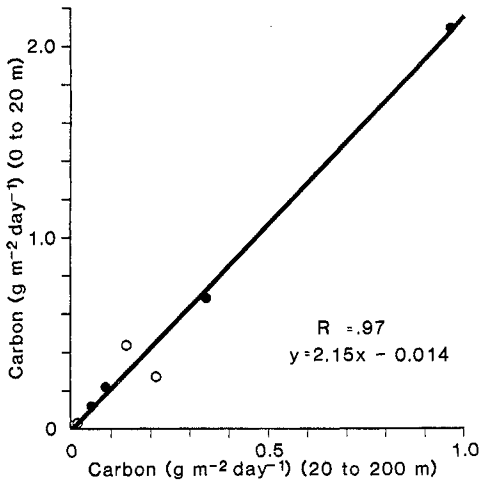

Fig. 1. Average areal primary production rates between two different isobaths on the Georgia–South Carolina continental shelf. Data shown as dots are from (*9*), and data shown as circles are from (*10*) (seven cruises). A similar result is obtained for community plankton respiration for five cruises [R^2 (coefficient of determination) = .97] (*13*). The coefficient of variation for data from any depth zone, on any cruise, ranges from 50 to 150 percent.

One way to test the hypothesis that the plankton communities of the nearshore and deeper waters are strongly coupled is to examine the fidelity of the seasonal changes in each zone. Figure 1 presents data for the average shelfwide primary production per square meter in each depth contour for seven different cruises. The relationship between the rates observed in each area is directly linear. A similar result is obtained if one computes the average community plankton respiration in the upper 10 m for each depth contour on five cruises (*13*). The implication is that there is both a constant shelfwide flushing rate (*5*) and that significant intrusion events do not overwhelm the influence of the nearshore zone.

Why do Yoder *et al.* not reach the same conclusion? They and others have faithfully discerned the details of eddy meanders and intrusions on the shelf. These and other physical oceanographic shelf processes result in a nonhomogeneous distribution of all materials, regardless of origin, across the shelf. The among-sample coefficient of variation is typically 50 to 120 percent for plankton communities on this shelf (for example, Fig. 1). To see the broad patterns, one must examine a larger perspective. Thus, Bishop *et al.* (*14*) found no evidence for a seasonal pattern in primary production between land and the 20-m isobath off Savannah, Georgia, whereas Thomas did (*15*). Bishop sampled two to three stations monthly, and Thomas sampled up to 36 stations monthly. Thus, Bishop *et al.* (*14*) found no correlation between primary production in nearshore and deeper waters by sampling one transect; if processes across the whole shelf are averaged, a coupling does emerge (Fig. 1).

Yoder *et al.* also state that the outer shelf is characterized by strong currents that sweep nutrients and plants from the region. I agree, and I assume that they agree that intrusion-introduced nutrients are lost as well, thus diminishing the nutrient residence time and ultimate impact. But, even if we disregard this neglect and also their assumption that nitrate, not ammonia, is limiting phytoplankton growth (*16, 17*) [ammonia, not nitrate, is apparently in higher concentrations (*8*) and should be the preferred nitrogen source for phytoplankton (*18*)], the amount of nitrogen flushed out of coastal marshes and across the whole shelf is 2.2 times their estimate for nitrogen introduced from intrusions (*17, 19*).

Weinstein presents a valid integration of fish biology into the shelf ecosystem, which we did not fully appreciate earlier (*10*). The majority of commercial finfish species on this shelf, as well as shrimp (*20*), spawn on the outer shelf, migrate to estuaries, and then return as subadults. This phenomenon is evidence of an overwhelming coupling of an organism's life history with events on the inner and outer shelf. It is reason enough to be cautious of unintentionally and detrimentally disturbing continental shelf ecosystems by means of a long-distance manipulation of estuaries.

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19. B. Kjerfve and H. N. McKellar, Jr., in *Estuarine Perspectives*, V. S. Kennedy, Ed. (Academic Press, New York, 1980), p. 341. The net nitrogen outwelling from a South Carolina coastal marsh was estimated to be 37 g m^{-2} year^{-1}. There are 3.25×10^5 hectares of coastal marshes in coastal South Carolina and Georgia, and so the total annual outwelling as nitrogen might be 1.2×10^5 metric tons.
20. R. E. Turner, *Trans. Am. Fish. Soc.* **106**, 411 (1977); S. Snedaker, personal communication.
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