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Urban anglers' perception of risk from contaminated fish

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Abstract

The Newark Bay Complex includes the Newark Bay, tidal portions of the Hackensack River, Passaic River, Arthur Kill, and Kill van Kull. It is a highly industrialized urban area including five counties and more than 20 local governments with a large racially-mixed population of more than 3 million people. In 1982, research conducted by the New Jersey Department of Environmental Protection (NJDEP) showed elevated levels of chemical contaminants in five species of fish and one type of crab in the Newark Bay Complex. Subsequently, the State of New Jersey adopted advisories to guide citizens on safe consumption practices for fish and crabs. Since then, fish consumption advisories have been issued primarily through the *Fish and Game Digest*, a publication distributed by the state to licensed anglers. However, anglers in the Complex are not required to have a fishing license because the waters are marine. Therefore, most anglers in this area do not receive advisory information. To gain greater insight into the information sources and risk perceptions of urban anglers, a survey was conducted of 300 anglers at 26 fishing and crabbing locations in the Newark Bay Complex during the summer and early fall of 1995. The objectives of the study were to learn anglers': (1) knowledge of fish consumption advisories; (2) belief in the advisories; (3) perception of how safe fish are to eat; (4) sources for information about fish and fishing; and (5) sources for information on fish consumption advisories. The study concluded that while 60% had heard about advisories, they either did not believe or were unconcerned about health effects from eating contaminated species. In addition, the most used source for information about fish and fishing was other fishermen, while newspapers were selected as a source for information about community news, health, and food safety. © 1999 Elsevier Science B.V. All rights reserved.

Keywords: Risk perception; Human health; Urban anglers; Fish contamination; Consumption

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Newark Bay Study Area
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1. Introduction

The Newark Bay Complex in New Jersey can best be characterized as a highly industrialized urban area with a tidal river system that runs through more than 20 municipalities in five counties, consisting of a large racially- and culturally-mixed population of more than 3 million people. The Complex includes the Newark Bay, Hackensack and Passaic Rivers, the Arthur Kill and the Kill Van Kull. The Complex, which is part of the Port of New York–New Jersey, is the third largest port in the United States, with both active and closed landfills, power plants, waste water treatment plants, and commercial and residential properties lining its shores. It is estimated that the port industry produced 2% of the US Gross Regional Product and 1.3% of total regional employment (New York–New Jersey Port Authority, 1995).

Despite the heavy commercial and industrial use of the Complex, it is also heavily used by recreational anglers. With more than 20 marinas and public access sites for fishing, plus those favored by anglers that are not official public access sites, the Complex is used for recreational fishing and crabbing on a daily basis during the fishing season. However, commercial fishing in the area has been closed for many years due to sediment contamination caused by years of legal and illegal industrial discharge to the rivers and bay (Shaw, 1994). In the 1970s, state and federal surveys found high levels of polychlorinated biphenyls (PCBs) in fish and crabs throughout the New York Harbor (Barclay, 1993).

In the early 1980s, fish tissue research conducted by the New Jersey Department of Environmental Protection (NJDEP) showed elevated levels of dioxins and polychlorinated biphenyls (PCBs) in five species of fish and one type of crab in the Newark Bay Complex (Belton et al., 1982, 1985). Subsequently, in the early 1980s, the state adopted fish consumption advisories to guide citizens on safe consumption practices. The species under advisory include bluefish (*Pomatomus saltatrix*), blue claw crab (*Callinectes sapidus*), American eel (*Anguilla rostrata*), white perch (*Morone americana*), striped bass (*Morone saxatilis*), and white catfish (*Ameiurus catus*). Advisories range from do not eat, to eat no more than once per week or once per month depending on whether consumers are considered to be a member of a high-risk group, or a member of the general population. High-risk individuals are women of child-bearing age, pregnant and nursing women, and infants and children up to 15 years of age (Christini, 1993; Hauge, 1993; New Jersey Department of Environmental Protection, 1994). The primary health effects of concern from exposure to dioxins and PCBs are reproductive disturbances, developmental problems and an increased risk of cancer (Jacobson and Jacobson, 1996).

Dioxin is the most biologically potent member of a large chemical family of related dioxins and furans. Dioxin is an unwanted industrial byproduct formed through numerous processes including production of chlorinated phenol products such as herbicides, the incineration of municipal solid waste, and creation of paper products using bleach. Most of what we know about dioxin has been obtained through animal toxicity testing in the laboratory and representative wildlife species. Dioxin produces a number of effects in animal toxicity testing including suppression of the immune system, impaired reproduction, birth defects in some species tested, dermal toxicity of which chloracne is an indicator of human exposure, alterations in liver function, and carcinogenesis. The US Environmental Protection Agency (EPA) has classified dioxin as a probable human carcinogen. Polychlorinated biphenyls (PCBs) were commercially produced for industrial application in heat transfer systems, hydraulic fluids, and electrical components. PCBs produce similar effects to dioxin in animal testing and are also classified by the EPA as a probable human carcinogen.

Because of the results of fish tissue samples from fish in the Newark Bay Complex, New Jersey has issued fish consumption advisories annually since the early 1980s. Signs and press releases, with heavy dependence on the *Fish and Game Digest*, a publication with fishing regulations and fish consumption advisories which is distributed to anglers at the point of fishing license purchase are used. However, fishing licen-

ses are not required for marine or estuarine waters such as those in the Newark Bay Complex, and therefore advisory information contained in the *Fish and Game Digest* may not reach anglers who fish these waters. Signs, while useful reminders of state advisories at favorite fishing locations, come down or are vandalized almost as quickly as they are posted and press releases are published at editors' discretion, subject to interest in the topic, and need for news fillers. Therefore, the primary information channels through which the State communicates may not have been effective in reaching this target audience.

To increase the opportunity for urban anglers to receive health risk information, a community-based outreach program was designed to incorporate local issues and concerns (Pflugh et al., 1992). This was achieved by establishing local site teams throughout the Newark Bay Complex with representatives from the target community who instructed the state in the most effective and appropriate outreach strategies for their community. At the end of the first year of the project, a mid-term evaluation was conducted to learn whether the outreach activities had been effective in discouraging consumption among urban anglers. The evaluation indicated that anglers were still consuming fish and crabs, and were either unaware or unconcerned about state fish consumption advisories. This indicated a need to have a better understanding of angler's risk perception and health as it related to consumption of fish and crabs. Rather than make assumptions (Morgan and Lave, 1990) about angler's knowledge and perceptions of health effects from eating contaminated fish and crabs, we believed information should be gathered from the target group itself.

This paper discusses urban anglers' perception of the health risk relative to consumption of contaminated fish and crabs, knowledge of and belief in fish consumption advisories and who anglers trust to deliver risk information. Ethnic aspects of information transfer are discussed elsewhere (Burger et al., 1998; Burger et al., in press). An angler survey was developed to collect this information. The objectives of the survey were to learn anglers':

1. demographics;
2. perception of how safe the fish are to eat;
3. awareness of fish consumption advisories;
4. sources for learning about the advisories;
5. belief in health effects from consuming fish under advisory; and
6. sources for information about fish and fishing.

These factors would then be used to design an outreach program that incorporated the needs and concerns of urban anglers while addressing any misperception or lack of information they had regarding health and fish consumption advisories.

In developing this study, discussions with members of the local environmental and fishing community suggested the existence of an active subsistence fishery in the Newark Bay Complex, particularly among Hispanic populations. Site visits to fishing and crabbing locations appeared to confirm this claim. One study of this region found that fish and shellfish are a traditional part of the diet of Hispanics in metropolitan New York City; 11% of those interviewed were consuming fish caught from local waters and only 27% of those interviewed were aware of fish consumption advisories (Zeidner, 1995). Another study of anglers in the New York–New Jersey estuary found that although 60% of anglers in the Arthur Kill reported hearing warnings about consuming fish caught in these waters, 70% of fishermen and 76% of crabbers said they ate their catch (May and Burger, 1996). A New York State study (Connelly et al., 1993) of licensed anglers surveyed through the mail found that while 90% of respondents had heard about the New York State health warnings, many continued to eat sport-caught fish. The findings of these studies are of particular concern given the recent study which concluded exposure before birth to relatively small amounts of PCBs can result in long-lasting deficits in a child's intellectual development (Jacobson and Jacobson, 1996).

Studies with laboratory animals indicate that chemicals such as PCBs can cause impaired locomotory ability in rodents, impaired learning in rodents and monkeys, and impaired cognition in monkeys. For example, mice treated in utero with

PCBs demonstrated signs of neurotoxicity, such as intermittent stereotypic circling, head bobbing, and hyperactivity in adulthood (Tilson et al., 1990); and monkey offspring whose mothers were exposed to PCB mixtures during gestation and lactation were impaired in their ability to respond in a learning reversal paradigm (Schantz et al., 1989).

There are several epidemiological studies in humans that examine neurological and cognitive disruptions as a result of exposure to chemicals such as PCBs and DDTs: Jacobson's PCB fish ingestion studies (Jacobson et al., 1985, 1989, 1990), Guo's Taiwan studies (Guo et al., 1995), Rogan's North Carolina studies (Rogan et al., 1986), Schwartz's et al. (1983) fish consumption study and Koopman-Esseboom's studies of breastmilk in the Netherlands (Koopman-Esseboom et al., 1994a,b). In most cases these studies examine children, and there is a well established strategy for assessing whether pediatric populations are suffering neurobehavioral deficits (Krasnegor et al., 1994). In those studies dealing with children, despite confounding factors, most (Harada, 1976; Hsu et al., 1985; Yu et al., 1991; Chen et al., 1992; Jacobson et al., 1990, 1992) showed that children exposed to PCBs had developmental delays and deficits in short-term memory. The children were described as dull, apathetic, and hypotonic with lower IQs, some with hepatoma, liver cirrhosis, liver diseases, and skin symptoms, and some with hyperpigmentation.

The lack of knowledge of health effects and the perception that fish are safe to eat could be one of the barriers to compliance with fish consumption advisories. In a previous study of the region it was found that fishermen in Jamaica Bay, New York believed they could tell if fish were unsafe by its appearance and odor (Burger et al., 1993). Kraus et al. (1992) had similar conclusions. Additionally, a recent study of food safety issues comparing lay-people with scientists concluded that lay-people have more faith in their own sensory powers to determine whether or not a seafood has been adversely affected by a pollutant. They believe that pollutants will negatively affect the flavor of fish and shellfish (Johnson and Griffith, 1996). Anglers also may have difficulty believing health effect claims because the potential harm is too far in the future and too hypothetical to be taken seriously, suggesting that people may underestimate significant risk (Belton et al., 1986; Burger et al., 1993). A possible reason for this could be that fishing and eating of self-caught fish and crabs is a familiar and non-threatening activity that anglers voluntarily engage in, thus diminishing their perception of risk or potential harm (Slovic, 1987).

We hypothesized that the typical urban angler in the Newark Bay Complex was: male, retired, predominantly Hispanic, low income, using fish and crabs as a major source of protein, lacking knowledge of advisories, and lacking understanding of health impacts.

2. Method

Interviews were conducted with urban anglers at 26 fishing and crabbing sites around the Newark Bay Complex (Fig. 1). In-person interviews at fishing locations were selected because it would greatly increase the likelihood of reaching urban anglers who were fishing in the Complex and possibly consuming contaminated species. A pretest of the survey was conducted in early July, and interviews were conducted from July through October 1995 for 39 field days. A team of two interviewers was responsible for approximately six sites each field day. Not all sites were visited every field day, but all sites were visited on Sunday–Saturday to get a sample of anglers at each site on different days of the week and to determine if some days were more popular than on other days (Table 1). This helped to ensure the inclusion of the widest possible cross section of the angler population in the survey. Because access to most sites required cars, interviewers drove from site to site or visited sites by boat at least twice each field day in order to interview anglers who might arrive at different times during the course of the day. Interviews took approximately 15–20 min to complete. As near as possible, interview teams tried to enter the field during high tide, the time when anglers would most likely be fishing and crabbing.

Contingency tables were developed which compared responses of risk perception, and informa-

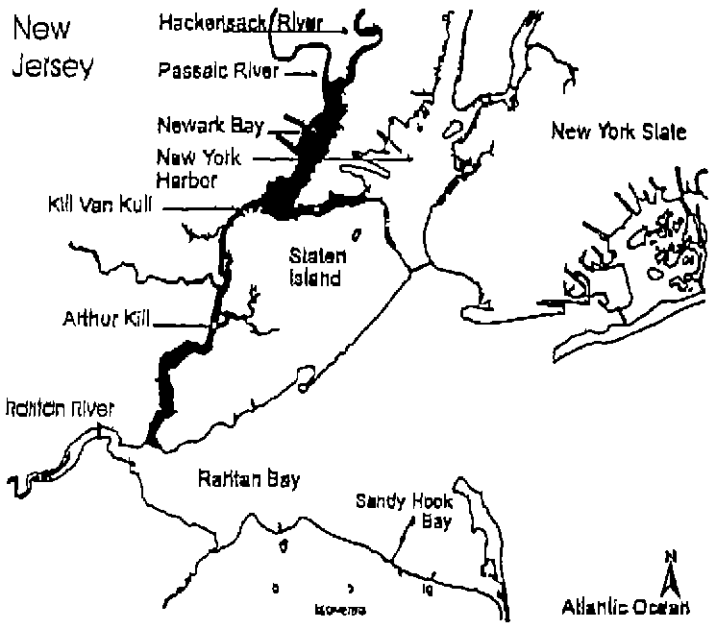


Fig. 1. Map of Newark Bay Complex.

Table 1
Day of the week for each survey

Day	Total number of surveys completed	Percentage of total surveys (%)
Monday	43	14.33
Tuesday	31	10.33
Wednesday	54	18
Thursday	45	15
Friday	25	8.33
Saturday	54	18
Sunday	48	16

tion seeking behavior to selected demographic data. Those comparisons which showed a significant association (i.e rejected the null hypothesis of no association with a probability of 5% or less using χ^2-test) were further analyzed to determine which demographic factors were most responsible for the significant association. In some instances, categories were grouped together. For example, Japanese, Chinese and Korean were regrouped into 'Asian' and Cuban, Puerto Rican, Mexican and other Latinos were combined into 'Hispanic'.

Seven open-ended questions were included in the survey. Response categories were created for those questions in order to analyze results. For the question dealing with safety of consumption, we asked how they made their judgement. Three categories emerged — personal knowledge, environmental conditions and media/communications. These categories helped us group similar responses to observe any trends or patterns in how respondents evaluate their perceptions. For example, respondents who said the fish were safe to eat, and gave answers such as 'I have been eating these fish all my life and nothing ever happened to me' or 'I can tell which fish are bad by the way they look or smell' constituted the personal knowledge category. Another example is the question asking respondents to describe the fish consumption advisories. A correct answer included some statement that related specifically to the advisory for that body of water or species or the contaminants of concern. An example of a correct answer would be 'fish are unsafe to eat due to chemical contamination or due to dioxin or PCB poisoning'. An incorrect answer would be 'crabs have worms and the water has too much pollution'. This was viewed as an incorrect answer

because it was a personal observation related to the water and made no mention of the language reflecting health risk which is stated in the advisory.

This paper provides an overview of our findings with respect to information and information sources about fish and fishing, health information and community news. It focuses on responses of all anglers interviewed in the study. Specific sociodemographic analyses and risk from consumption will be reported in future papers (Burger et al., in press).

3. Results

Four hundred and twenty-one persons were approached; 300 interviews were completed. The response rate was 74%, with 4% declining because of language difficulties and 22% refusing to participate because they didn't want to be interviewed while they were fishing or crabbing. At the time of the interview, the type of activity observed was 147 people crabbing, 144 people fishing and nine both crabbing and fishing. Sites were selected through the assistance of local anglers who were familiar with local fishing activities.

3.1. Angler demographics

Ninety-one percent ($n = 272$) of the anglers surveyed were male. The median age of anglers was 46. The largest ethnic group was Caucasian, 55% ($n = 165$), followed by Hispanic, 20% ($n = 60$), African-American 17% ($n = 52$), other, 5% ($n = 15$) and Far East, 3% ($n = 8$). The most frequently reported education level was high-school graduate, 45% ($n = 136$). For household income, 18% ($n = 55$) reported it was between $25 000 and $34 999 and 18% ($n = 53$) said their household income was below $15 000. Eighty-three percent of the complex's urban anglers said they were most comfortable reading English (Table 2). According to 1995 Federal guidelines, the average poverty threshold for a family of four is $15 569 (Federal Census Bureau, 1995). However, it should be noted that although 18% of households fall below this, we did not ask household size.

Table 2
Selected angler demographics ($N = 300$)

	(%)	n
Age (years)		
< 20	3	8
20–29	9	28
30–39	26	77
40–49	18	53
50–59	13	40
60–69	18	55
70–79	11	32
≥ 80	2	7
Education		
Less than high-school graduate	28	85
High-school graduate	45	136
Some college	16	47
Associates degree	3	9
Bachelors degree	6	17
Graduate/professional degree	2	6
Annual household income ($)		
> 10 000	11	33
10 000–14 999	7	20
15 000–24 999	15	46
25 000–34 999	18	55
35 000–49 999	14	43
50 000–74 999	13	39
75 000–99 999	6	17
≥ 100 000	5	15
Would not answer	11	32
Sex		
Male	91	272
Female	9	28
Ethnicity		
Caucasian	55	165
African-American	17	52
Hispanic	20	60
Far East	3	8
Other	5	15

3.2. Type of activity

Respondents' 'fishing' activity was recorded based on interviewers' observations during the time of the interview. The categories recorded included: fishing, crabbing or both fishing and crabbing. Of the female respondents ($n = 28$), 64% were crabbing, 29% were fishing and 7% were both fishing and crabbing. There was a

Table 3
Respondents' activity at time of survey

	Crabbing (%)	Fishing (%)	Both crabbing and fishing (%)
Sex			
Male	47	50	3
Female	64	29	7
Age (years)			
< 20	75	12.5	12.5
20–29	39	57	4
30–39	52	43	5
40–49	60	38	2
50–59	52.5	47.5	0
60–69	55	45	0
70–79	31	63	6
≥ 80	29	71	0
Ethnicity			
Hispanic	67	28	5
African-American	33	61	6
Caucasian	47	51	2
Far East	37.5	62.5	0
Other	67	33	0
Language-most-comfortable reading			
English	46	51	3
Spanish	72	24	4
English/Spanish	53	41	6
Korean	50	50	0
Other	80	20	0
Education			
No H.S. diploma	56	40	4
High-school graduate	51	46	3
Some college/ no degree	51	45	4
Associates	33	67	0
Bachelors	29	71	0
Graduate/ prof. degree	46	51	3
Annual household income ($)			
< 10 000	61	36	3
10 000–14 999	65	25	10
15 000–24 999	50	47	3
25 000–34 999	49	47	4
35 000–49 999	33	65	2
50 000–74 999	38	62	0
75 000–99 999	47	53	0
≥ 100 000	60	33	7

statistically significant difference in the type of fishing activity by gender ($P = 0.06$). Women were more likely to crab than fish. Of the male respondents ($n = 136$) 50% were fishing ($n = 129$), 47% were crabbing and ($n = 7$) 3% were both fishing and crabbing. Respondents with household incomes of between $35 000 and $49 999 were more frequently observed fishing while respondents with household incomes under $15 000 were more frequently observed crabbing (Table 3). Looking at the relationship of ethnicity and activity type, Hispanics were more frequently observed crabbing than fishing. Finally, those respondents who were 70 years and older were more frequently observed fishing while those respondents who were less than 50 years were more frequently observed crabbing, with the greatest percent crabbing between the ages of 40 and 49 (Table 3).

3.3. Perception of safety of consuming fish

When respondents were asked whether they thought fish from local waters were safe to eat, 47% ($n = 140$) said they were safe to eat, 34% ($n = 102$) said they were not safe, 15% ($n = 45$) don't know and 4% ($n = 13$) responded with 'maybe' (Fig. 2).

To get a better understanding of the respondents risk perceptions, they were asked the basis for their judgement on the acceptability or non-acceptability of the fish for consumption. Fifty-nine percent of all respondents gave an environmental condition as their reason, such as 'if the water was polluted there would be no fish', or 'the fish are unsafe to eat because of runoff from industry'. And 39% gave 'personal knowledge' responses such as, 'I've been eating them all my life and have never gotten sick' (Table 4).

3.4. Awareness of fish consumption advisories

Respondents were asked whether they had heard of fish consumption advisories in the Newark Bay Complex. Although 60% ($n = 180$) of anglers said they had heard of warnings against eating some fish in local waters (Fig. 3), when

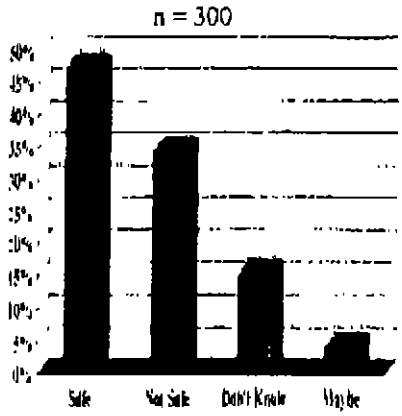


Fig. 2. How safe to eat are the fish you catch in local waters?

asked to describe the advisories, only 15% (n = 46) of the respondents could correctly state the advisories (Fig. 4).

3.5. Sources for fish consumption advisory information

Anglers were asked where they had heard about the fish consumption advisories. Sixteen possible sources for information about fish consumption advisories were offered (Table 5). Respondents could give more than one answer. Of the options offered, the three sources most frequently cited for where they had heard about fish consumption advisories were — newspapers 27% (n = 80), signs 19% (n = 58) and television 13% (n = 40).

3.6. Sources for information about fish and fishing

Respondents' were offered 17 possible sources such as newspapers, bait and tackle shops, and friends from which to select for sources of information about fish and fishing. Respondents could give more than one answer. Several sources were not selected by any respondents. The sources for information about fish and fishing most frequently used by anglers were — other fishermen 64% (192), bait and tackle shops 38% (114), newspaper 30% (90), and cable television 19% (56) (Table 6). To get a better sense of what might influence information source selection, we looked at the relationship of age, income and language-most-comfortable reading with source of information. There was a statistically significant difference in respondents' use of newspapers as a source of information about fish and fishing by age group (P = 0.0002); the greater the age of the angler, the more likely that newspapers were used as a source of information about fish and fishing. There was also a statistically significant difference in the respondents' use of other fishermen as a source of information about fish and fishing, by household income (P = 0.04); as income increased, the angler was more likely than not to rely on other fishermen as a source for information about fish and fishing (Table 7). Additionally, for those with household incomes between $15 000 and $24 999, only 8% reported using cable T.V. as a source for information about fish and fishing and no one in this income range reported using radio (Fig. 5).

In comparing language most comfortable reading to source for information about fish and fishing, again, other fishermen was most frequently

Table 4
Response categories for perception of safety of consuming fish[a]

(%)	n	
Environmental conditions response	59	177
Personal knowledge response	39	116
Media (communications) response	9	26
Don't know	11	32

[a] More than one response could have been given by angler.

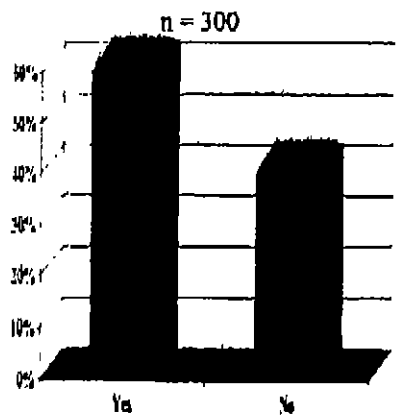


Fig. 3. Are you aware of any warnings about eating locally-caught fish?

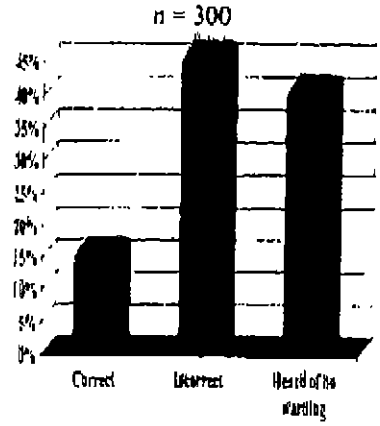


Fig. 4. What are the warnings?

selected as a source for information about fish and fishing for all respondents. Also, for those people who are comfortable reading both English and Spanish, only 11% relied on newspapers as a source for information about fish and fishing. Respondents most comfortable reading Spanish did not use magazines at all as an information source for this issue (Fig. 6).

In addition to asking about sources for information about fish and fishing, we also asked respondents what they use to obtain information about health, food safety and community news. Again, respondents were offered a number of choices and could select more than one answer. Interestingly, 73% of the respondents most frequently selected newspapers as a source for information about community news, 36% selected newspapers as a source for information about food safety and 33% selected newspapers as a source for information about health-related issues (Fig. 7).

3.7. Belief in health effects

To gain knowledge of urban anglers belief in health effects from eating contaminated fish and crabs, three statements were read to respondents concerning the health impacts. The statements were developed based on toxicological interpretations of health risk. After reading the statements, interviewers asked anglers if they agreed or disagreed with the statements. Thirty-eight percent

Table 5
Sources of fish consumption advisory information ($N = 300$)[a]

	Respondents who answered yes (n)	(%)
Newspaper	80	27
Signs	58	19
T.V.	40	13
Other	35	12
DEP digest	14	5
Friends	11	4
Radio	9	3
Bait and tackle	8	3
Health department	4	1
Magazine	3	1
DEP brochure	3	1
Newsletter	2	< 1
Doctor	1	< 1
Baykeeper brochure	0	
Fishing guides	0	
Marina	0	

[a]Angler could have more than one source.

($n = 115$) agreed with the statement, 'Eating locally-caught fish/crabs over your lifetime may increase your risk of developing cancer', while 34% ($n = 102$) disagreed and 28% ($n = 83$) didn't know. Thirty-six percent ($n = 109$) agreed with the statement, 'Women eating these locally-caught fish/crabs may increase the chance of harming the growth and development of their unborn children', while 29% ($n = 88$) disagreed and 35% ($n = 103$) didn't know. Thirty-nine percent ($n = 116$) agreed with the statement, 'Young children eating these locally-caught fish/crabs may increase the chance of harming their growth and development', while 31% ($n = 93$) disagreed and 30% ($n = 91$) didn't know. When the categories of 'do not know' and 'disagree' were collapsed for all three statements, an average of 62% of respondents either did not know or disagreed with the health risk advisories (Table 8).

4. Discussion

The objectives of this study were to develop an accurate profile of the Newark Bay Complex urban angler, to gain insight on perceptions on risk behavior in relation to the consumption of contaminated fish, and to determine who respon-

Table 6
Anglers' sources for information (percent of affirmative answers, $N = 300$)

Sources	Fish and fishing (%)	Health-related issues (%)	Food safety (%)	Community news (%)
Newspaper	30	33	36	73
Radio	3	7	9	10
Friends	3	6	4	24
Doctor	26	7	3	
Magazine	18	2	3	4
T.V.	19	21	35	29
Health department	*	13	6	2
Other	11	24	20	20
Bait and tackle	38	*	*	*
Other fishermen	64	*	*	*
Fishing group	7	*	*	*
DEP F and G digest	4	*	*	*
Newsletter	4	*	*	*
Marina	3	*	*	*
Fish market	2	*	*	*
No answer	0	11	18	3

Note. *, Answer category was not a choice for this question.

Table 7
Factors affecting anglers' reliance on information sources of fish and fishing ($N = 300$)

Source	Language	Ethnicity	Income	Education	Age
Media					
Newspaper	13.9 (0.02)	22.9 (0.0001)	NS	NS	28.8 (0.0002)
Radio	NS	NS	16.7 (0.03)	NS	NS
Cable T.V.	NS	NS	13.2 (0.1)[a]	10.4 (0.07)	NS
Magazine	15.0 (0.01)	NS	NS	9.9 (0.07)	NS
Newsletter	NS	NS	NS	NS	12.8 (0.07)[b]
Local sources					
Bait and tackle	14.0 (0.02)	NS	18.0 (0.02)	NS	NS
Marina	NS	NS	NS	NS	NS
Fish market	NS	NS	NS	NS	NS
Personal					
Fishing group	NS	NS	NS	NS	NS
Friends	NS	NS	NS	NS	NS
Other fishermen	12.6 (0.02)	NS	16.4 (0.04)	NS	NS
Authorities					
DEP	NS	NS	NS	NS	NS
Other sources	NS	NS	NS	NS	NS

Note. NS, not significant; given are likelihood χ^2.
[a] Pearson = 13.4 ($P < 0.09$).
[b] Pearson = 17.5 ($P < 0.01$).

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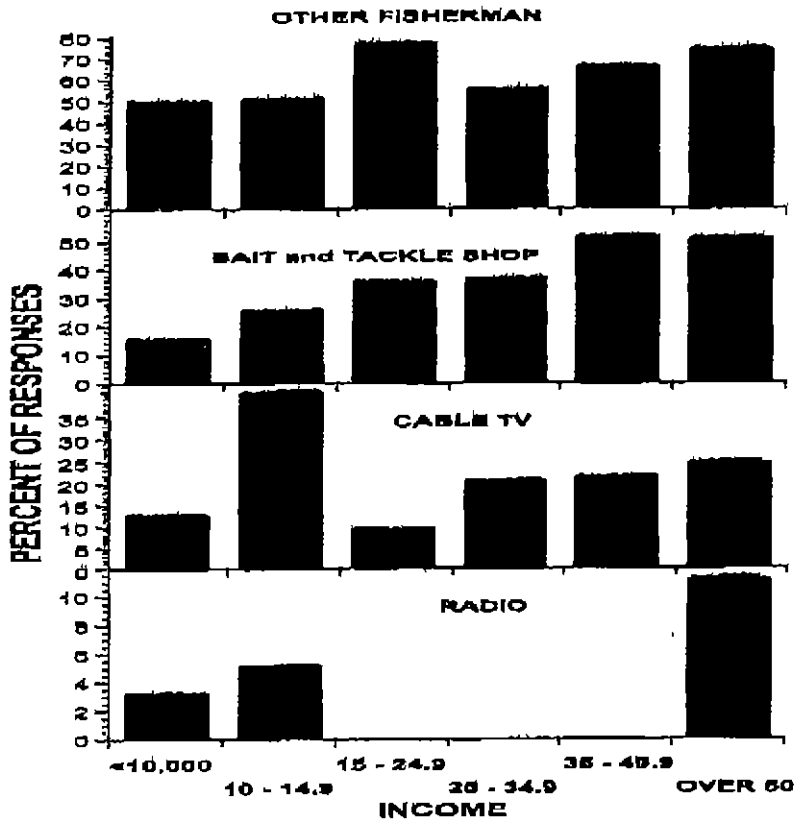


Fig. 5. Anglers' sources of information about fish and fishing by annual household income.

dents' trust to provide them with information about fish and fishing, food safety and health. These data will be used to develop an effective, targeted, outreach effort that incorporates the perceptions, concerns, and issues of urban anglers. Specifically, the study sought to learn how anglers in this area gain information about fish and fishing, who they trust to deliver this information and why they continue to consume contaminated fish and crabs despite health warnings.

The study revealed that most urban anglers were either unfamiliar or unconcerned about fish consumption advisories, supporting our initial hypothesis. However, the largest group of urban anglers were non-retired male Caucasians. It appears that the lower the household income and the younger the angler, the more likely they would be observed crabbing. There are several assumptions one could make about this observation. Crabbing requires less equipment and skill to perform, making it a more accessible activity. It is also easier to do, requiring little training and effort. Children of nearly any age who can drop a line in the water can crab and are likely to catch a crab. Because of the simplicity of the activity and the low expense, it makes it much more appealing for someone who may not be able to invest a great deal of time or money, yet still wants to fish and walk away with a catch. Finally, crabs taste good and do not require a great deal of preparation to eat. All these factors make it a challenge to change angler's behavior and attitudes toward catching and eating crabs that are contaminated but do not appear so.

The study also explored respondents risk perception and why they continue to consume contaminated fish and crabs despite health warnings. We concluded that a majority of respondents

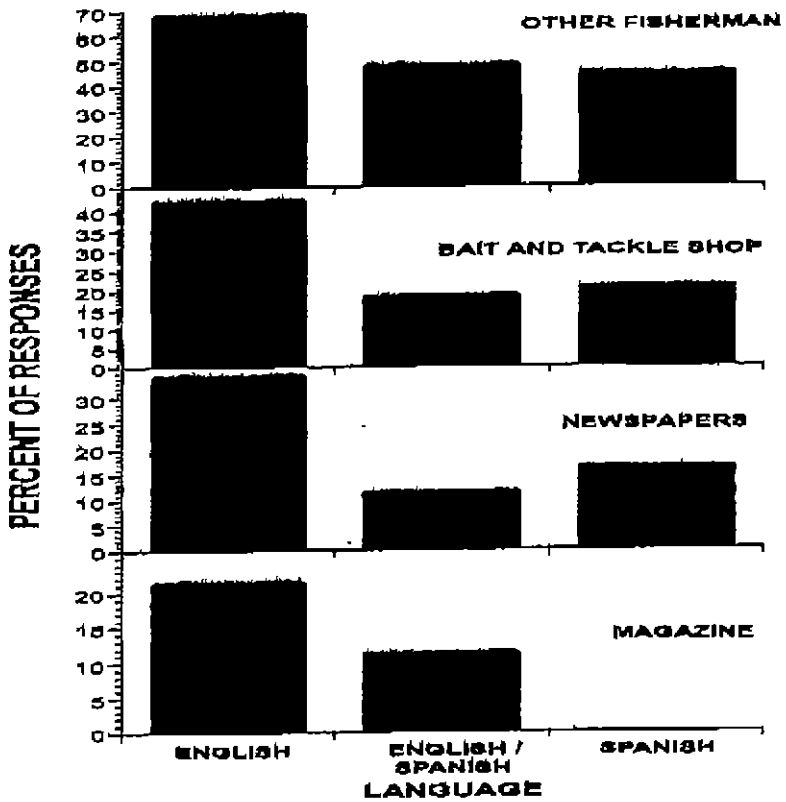


Fig. 6. Anglers' sources of information about fish and fishing by language-most-comfortable reading.

either 'disagreed' or 'did not know' about health affects associated with consumption of these species. One possible factor that may influence respondents' perception of risk and belief in health effects is that there are no immediate ill effects associated with consumption of species contaminated with dioxins and PCBs. In fact, many of those who disagreed with the health effects statements told us that their reasons for ignoring health effects claims were because, 'Nobody's died yet', or 'I've been eating them all my life and haven't gotten sick'. Also, the healthy appearance and good taste of the fish and crabs contributes to disbelief in the advisories, as suggested by many anglers we interviewed: 'If they were bad to eat, I'd know it. They'd taste bad'. To further support their contention that fish are safe to eat, many anglers reported engaging in behavior such as soaking or purging the fish which they believe eliminates contaminants making them safe to eat. Several anglers also claimed that crabs, in particular, are filter feeders which gives them the ability to filter toxins from their system making them safe to eat. These observations concur with similar ones made by May and Burger (1996) for part of the same region. Likewise, a study of anglers in the Barnegat Bay, NJ (Burger et al., 1998) found most anglers believe that fish they catch themselves or buy in a local fish market are safer than those from a supermarket. Studies of licensed anglers in New York State through mailed surveys had similar findings (New York State Department of Environmental Conservation, 1990; Connelly et al., 1992; Vena, 1992; Vena and Jadd, 1997). Finally, there may also be a credibility gap between angler's risk perception and the source for information about fish and fishing and health advisories (Hance et al., 1989; Mitchell, 1992).

This phenomenon of eating contaminated

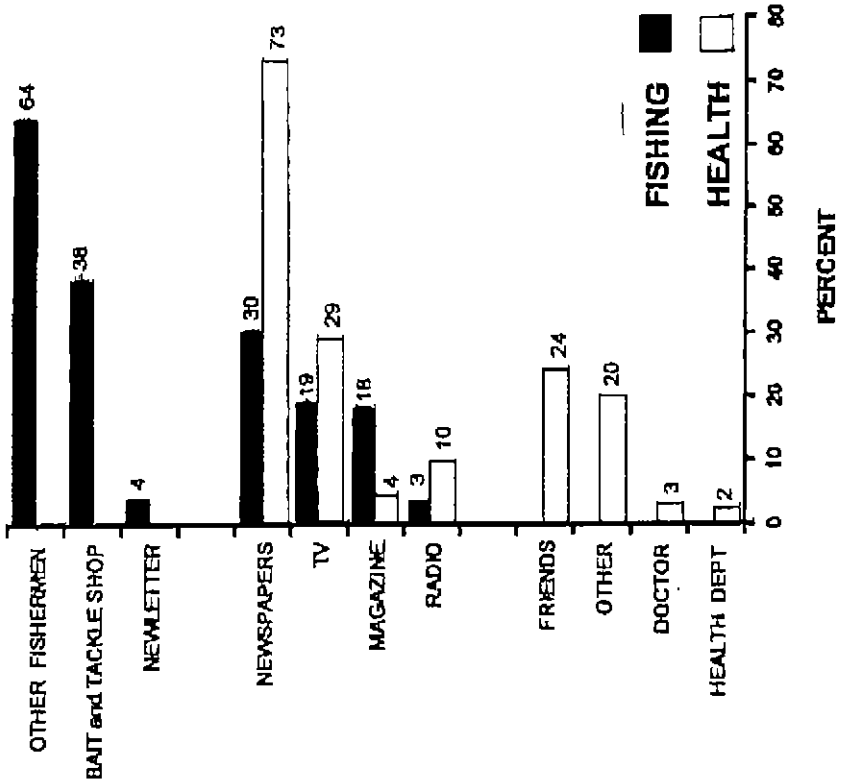


Fig. 7. Where angler gets information about health issues, food safety and community news.

species despite health warnings to the contrary also may be a manifestation of the voluntary vs. involuntary response to risk (Slovic, 1987). Clearly, fishing is a voluntary activity and while anglers are not responsible for contaminants found in fish, it appears tainted fish are viewed as an unavoidable component of an otherwise enjoyable activity and therefore the risk seems less risky. Likewise, for those people supplementing their diet with these fish, if the choice is between providing a meal for their families now or possibly getting sick at some future time, the percep-

Table 8
Risk assessment ($N = 300$)

Statement	Agree (%)	Disagree (%)	Don't know/ no answer (%)
Eating locally-caught fish/crabs over your lifetime may increase your risk of developing cancer.	38	34	28
Women eating locally-caught fish/crabs may increase the chance of harming the growth and development of their unborn children.	36	29	35
Young children eating these locally-caught fish/crabs may increase the chance of harming their growth and development.	39	31	30

tion of risk is diminished. Additionally, cultural traditions and practices may also influence the perception of risk (Barclay, 1993). Campbell (1989) found that minority groups approach recreational fishing from different cultural frameworks which in part determines the sites they access and the resources they actually exploit. Caucasians fished primarily for diversion between shifts or during lunch breaks, whereas Southeast immigrant groups fished for consumption. Others have found that even in urban areas, African-Americans may view angling more for its contribution to household consumption than do Caucasians, an orientation that may be dangerous in some urban areas because of polluted waters (West et al., 1992). Blahna (1992), reported much cultural similarity among ethnic groups, with the exception of Blacks and Hispanics, who were more concerned than were other groups with socializing while fishing (Toth and Brown, 1997). These factors should all be explored in future studies.

We learned that agencies cannot depend on the traditional means of communication — newspapers and television — as the primary or sole channel through which to communicate with the urban angler population about fish and fishing. Because anglers prefer to talk with other anglers about fish and fishing, more innovative strategies such as personal discussions with fishermen, and outreach through fishing clubs and bait and tackle shop owners will be more effective in reaching and educating this target audience. Despite this, however, we cannot overlook the influence of age, language and household income in selection of information sources for fish and fishing, and how this differs from selection of information sources for health, community issues and food safety. While anglers appear to rely on each other for information on fish and fishing, when asked where they turn for information about health, community news and food safety, the choice most frequently selected was newspapers. In addition, 27% indicated that newspapers were the source of information about fish consumption advisories. However, language must be considered, because while newspapers might be effective in reaching the English reading angler, only 16% of those anglers most comfortable reading Spanish use newspapers as a source for information about fish and fishing and only 12% of those anglers who are comfortable reading both English and Spanish rely on newspapers as a source for information. This means that while messages on health-related issues might be successfully communicated through newspapers for some people, issues related to fishing may not reach the same group. This poses a dilemma, in that we are concerned about health related issues associated with consumption of contaminated fish. Because this health issue crosses categories, a strategy that takes into account a target audience with diverse information seeking behaviors and trust in different communication channels to deliver different but related health-based information needs to be developed. In other words, a strategy that includes personal contact with anglers, as well as press releases to both English and Spanish language newspapers, is likely to be more effective in reaching this audience.

5. Conclusion

This study sought to identify the risk perceptions and knowledge of fish consumption advisories of recreationally caught fish and crabs among urban anglers in the Newark Bay Complex. Understanding these factors will assist in the development of an outreach program that incorporates the needs, concerns and issues of anglers in this region. We learned that while many anglers had heard about advisories, they could not correctly state them and many more did not know or did not believe there were health effects from eating contaminated fish and crabs. While outreach to people in this region in recent years has increased, these results suggest the need for additional study into the ways specific populations see and respond to risk information in order to identify the specific barriers to knowledge of and belief in health effects from eating contaminated fish and crabs. A reasonable goal for health and regulatory agencies is to create policies and engage in risk communication strategies that are appropriate and effective in vastly different socioeconomic and cultural contexts (Vaughan, 1995). Until the sociodemographic indicators for risk response and behavior can be clearly identified, changing the fish consumption habits among

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populations who either depend on or enjoy the opportunity to eat recreationally caught fish and crabs will continue to be a challenge.

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