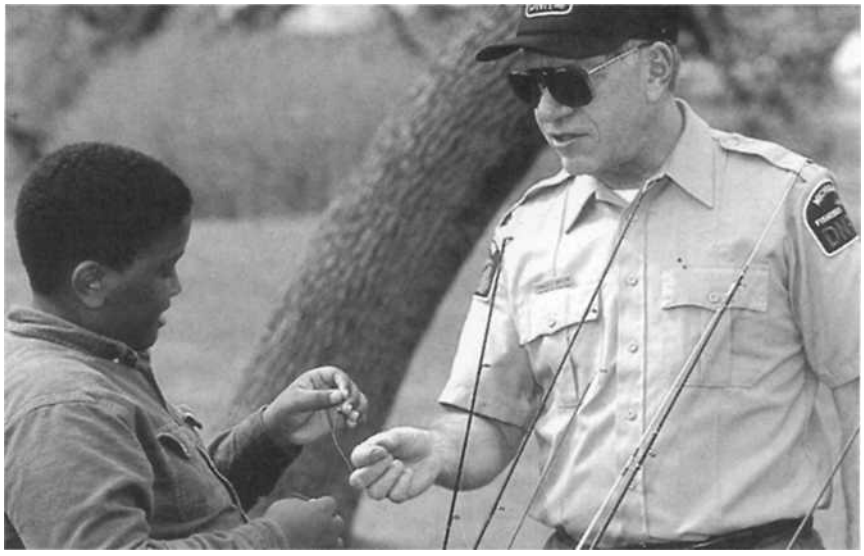
A Needs Assessment of Fisheries Education Materials for Youth

By Michaela Zint and Alan Crook

ABSTRACT

Many kindergarten (K) through twelfth grade fisheries education materials exist but have not been inventoried or reviewed to determine whether they meet the needs of fisheries professionals and educators. To identify instructional resources and guide curriculum developers, the Youth Education Committee of the American Fisheries Society Education Section (1) developed a fisheries education framework of 8 issues and 55 concepts, (2) identified and selected appropriate youth fisheries education materials, (3) reviewed the content of 51 materials based on the framework, (4) summarized results in a user-friendly guide, and (5) developed recommendations to fill gaps in information. Coverage of biodiversity (Issue 3) and some of the concepts associated with building sustainable fisheries (Issue 4) and promoting stewardship (Issue 6, 7) appear especially limited. Materials that target students in kindergarten to third grade and ninth- to twelfth-grade levels, that focus on global or marine fisheries, and that provide multicultural perspectives also are needed. Recommendations include revising or developing fisheries education materials based on our framework, using results from this assessment to avoid duplication, and developing partnerships to improve fisheries education materials for youth.

Many fisheries professionals and others interested in fish, fishing, and fisheries management issues view youth education as an important step in developing an informed, responsible citizenry (American Fisheries Society 1994). Such interest has resulted in support for fisheries education, which in turn has led to the development of youth education materials and programs that can be used in school (formal education) and out-of or away-from-school (nonformal education) settings. Nowhere, however, have these fisheries education materials been inventoried and reviewed to determine if existing instructional resources meet fisheries education needs. Therefore, it has been challenging for most fisheries professionals and educators to identify appropriate materials and for curriculum developers to decide what content new materials should include.



Dave Kenyon/Michigan Department of Natural Resources

Many local fisheries professionals recognize that they should be role models for students, and some volunteer personal time accordingly.

When the Youth Education Committee of the American Fisheries Society (AFS) Education Section was formed, it recognized these unmet needs and decided to review fisheries education materials for youth (Zint and Dann 1995). The Committee's plan for this review was to (1) develop goals and a framework for fisheries education, (2) identify fisheries education materials, (3) review the content covered by these materials based on the framework, (4) summarize results in a user-friendly

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guide to fisheries education resources, and (5) develop recommendations for youth fisheries education materials.

The idea for the guide was inspired by Andrews' (1995) review of water education curricula. The Committee closely followed her suggested format for providing a user-friendly description of instructional materials. The Committee's effort also was unique in that it began with content (fisheries in this case) rather than specific education objectives.

Methods

The Committee began by defining three goals for fisheries education (Table 1). These goals were based on the objectives for environmental education that emphasize awareness, knowledge, attitude, skill, and action (United Nations Educational, Scientific, and Cultural Organization 1978). Using the three goals, Committee members selected fisheries issues and concepts from the AFS (1994) vision statement to develop a draft, in-depth fisheries education framework. This framework was disseminated to all AFS Executive Committee (EXCOM) members through a mail questionnaire. Using two five-item bipolar disagree/agree Likert scales, EXCOM members were asked to what extent each of the framework's issues and concepts (a) reflected the Society's position and (b) represented an important topic to include in fisheries education (Table 2). Of the 89 AFS leaders who received the questionnaire in 1995, 65 responded (73% response rate). These respondents validated the proposed fisheries education framework, added six concepts, and provided some editorial changes.

With the framework in hand, Committee members identified and collected fisheries education materials for youth. To obtain the greatest number of potential materials, we selected more than 20 resources from members' libraries, placed requests for resources in a variety of newsletters (e.g., *EECOM Newsletter, Fisheries, 4-H Weekly, Lateral Line, NMEA News*) and reviewed four bibliographies (Gigar 1990, 1991; Broussard and Skupien 1994; Great Lakes Educators Advisory Council 1994; Andrews 1995) for relevant resources. In addition, the Committee requested more than 80 instructional materials directly from their sources; 46 were received. A nonresponse survey was not conducted and, therefore, it is unknown if the materials requested but not received would have met the review selection criteria.

At the same time the materials were collected, members were developing selection criteria based on a similar set by Andrews (1995). They concluded that materials must (1) cover one or more fisheries education issue or related concept; (2) be designed or adapted for youth; (3) be interactive (i.e., require thought or action) and not

(Continued on page 29)

Table 1 shows the three fisheries education goals.

Help youth acquire
Goal 1 ... a basic awareness and understanding of the total ecosystem in which fishes live; the commercial, sport, and subsistence fisheries supported by that ecosystem; the issues involved in managing these fisheries; and the impacts people can and do have on the resource.
Goal 2 ... positive attitudes and values toward fish, fishing, fisheries, and the aquatic ecosystem in general, ensuring their protection, rehabilitation, and responsible fisheries management.
Goal 3 ... the social and technical skills for making decisions and solving problems associated with fisheries management and the motivation to personally act on those problems—and to provide youth with the opportunities for personal action and for evaluating these actions.

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Charles Carter

Instructors are encouraged to use aquatic sites, fishing, and field trips to enhance their fisheries education efforts. ◆

Table 2 lists the 8 issues and 55 related concepts in the fisheries education framework, results from the AFS Executive Committee questionnaire validating the framework, and notes on whether these issues and concepts were covered by the reviewed materials.

Fisheries education issues and concepts	Reflects the AFS's position (n=65)	Should be addressed by fisheries education (n=65)	Issues and concepts covered by 13 secondary		all 51 materials	
	% strongly agree or agree		n	%	n	%
Issue 1: Maintain and recover fisheries habitat (Habitat).	98	100	11	85	47	92
1.1 Habitat forms a key element of sustainable fisheries.	89	89	7	54	33	65
1.2 Habitat protection, mitigation, and enhancement are primary fisheries management activities.	Added concept		4	31	13	26
1.3 Most aquatic ecosystems support, or could support, commercial, sport, and/or subsistence fisheries: streams, lakes, rivers, coastal waters, and open-ocean waters.	58	61	3	23	9	18
1.4 Particular aquatic or semi-aquatic ecosystems provide critical habitat for some species and include freshwater wetlands, floodplain/riparian zones, tributary streams, estuaries, tidal flats, and other saltwater wetlands. Loss of these habitats significantly reduces the potential of fisheries dependent on them.	98	99	9	69	30	59
1.5 Many critical habitats have been, and are, under significant pressure from historic and current development. A significant number have been damaged or lost.	100	99	11	85	37	73
1.6 Remaining critical habitats can be, and in some cases are being, protected and maintained; damaged habitats can be, and in some cases are being, rehabilitated.	97	96	8	62	30	59
1.7 Some former fisheries can be, and in some cases are being, reestablished through the reintroduction of native species into rehabilitated habitat.	89	72	3	23	9	18
Issue 2: Identify and reduce sources of pollution affecting fisheries habitat (Pollution).	100	94	11	85	45	88
2.1 One specific cause of fisheries habitat degradation is pollution that can affect both water and substrate quality.	97	99	10	77	39	77
2.2 In general, sources of pollution must be stopped or reduced if safe, good-quality fisheries are to exist.	94	95	7	54	29	57
2.3 Pollutants fall into a number of categories, including acid rain, agricultural/landscape (e.g., lawns, golf courses, roads) runoff, biological (e.g., exotics, disease), industrial (toxic) waste/spills, postconsumer petroleum products, sewage, silt or sediment, and thermal, radioactive, and solid waste (especially litter/plastics). Each of these impact fisheries habitat and, if the pollution is bad enough, may cause habitat loss.	99	97	11	85	42	82
2.4 Point-source pollutants enter the environment from a specific point (e.g., sewage outfall) that can usually be identified.	93	79	4	31	18	35
2.5 Nonpoint-source pollutants usually enter the environment from numerous sources (e.g., lawn fertilizer runoff, pesticides, acid rain) and can be harder to identify and treat than point-source pollutants.	95	92	5	38	21	41
2.6 Although industries and sectors (e.g., government) have a responsibility to control potential pollutants, each individual also has a responsibility to act in ways that can directly or indirectly reduce the impacts of pollutants on the environment.	95	97	5	38	32	63

Table 2 continued.

Fisheries education issues and concepts	Reflects the AFS's position (n=65) % strongly agree or agree	Should be addressed by fisheries education	Issues and concepts covered by 13 secondary		by all 51 materials	
			n	%	n	%
Issue 3: Maintain and rebuild biodiversity within commercial, sport, and subsistence fisheries (Biodiversity).	82	69	9	69	32	63
3.1 The ecological values related to biodiversity apply to commercial, sport, and subsistence fisheries.	72	63	1	8	5	10
3.2 Biodiversity issues need to be addressed at the individual (genetic), population (stock), species, and community levels.	85	69	0	0	4	8
3.3 In particular, the trend toward decreased species and population diversity needs to be reversed.	77	68	2	15	11	22
3.4 Decreased diversity can occur through habitat loss, overharvest, intentional or accidental species introductions, and the effects of some stocking practices on genetic or stock variability.	94	83	4	31	9	18
3.5 Introductions have the potential to reduce the diversity of native systems and need to be carefully controlled.	94	90	5	38	22	43
3.6 Commercial fisheries in particular may directly impact the diversity of nontarget species (e.g., entanglement of marine mammals or turtles in active or "ghost" nets; habitat destruction), and means must be found to limit this type of conflict.	Added concept		2	15	8	16
Issue 4: Build sustainable commercial, sport, and subsistence fisheries (Build sustainable fisheries).	97	89	13	100	45	88
4.1 Both historic and current fisheries have considerable economic, cultural, and social significance.	97	92	13	100	40	78
4.2 Both historic and current fisheries losses and closures have considerable economic, cultural, and social impact.	95	94	6	46	16	31
4.3 Given projected world population increases, the value of future fisheries will likely increase, as will pressure on them; a global perspective will be required to appropriately plan and manage fisheries.	96	84	1	8	5	10
4.4 The act of fishing, including type and intensity (harvest), forms a key element of sustainable fisheries.	80	79	3	23	11	22
4.5 Self-control, regulation of harvest, and promotion of alternative methods (e.g., selective harvest, different netting techniques) and species are primary fisheries management activities.	Added concept		7	54	26	51
4.6 Stocking is an important management tool; it has the potential to have both positive and negative consequences.	95	92	6	46	21	41
4.7 Overfishing can and does threaten sustainable fisheries and must be controlled.	97	95	10	77	33	65
4.8 Research and assessment are critical to determining sustainable levels of catch for any fishery.	95	89	9	69	23	45
4.9 Controlled commercial aquaculture can contribute to sustainability by reducing pressure on wild populations. Key concerns include introduced populations and potential escapes, stock genetics, and genetic engineering.	84	70	6	46	13	26
4.10 Enforced legislation and international agreements are essential to maintaining sustainable fisheries.	91	78	7	54	25	49
4.11 Public awareness, understanding, and action related to the biological, economic, cultural, and social consequences of overharvest are important to maintaining sustainable fisheries in general and are critical for sport fisheries.	94	89	5	38	8	16
4.12 Bycatch can and does threaten sustainable fisheries and must be monitored and controlled; move toward						

Table 2 continued.

Fisheries education issues and concepts	Reflects the AFS's position (n=65)	Should be addressed by fisheries education (n=65)	Issues and concepts covered by 13 secondary		all 51 materials	
	% strongly agree or agree		n	%	n	%
"no-waste" fisheries. Perspectives on bycatch are different in the developing world, where bycatch is often used locally for food; this use must be accommodated without threatening sustainability of the resource.	84	76	3	23	9	18
4.13 Contaminants and their bioaccumulative risks to both species and human health threaten sustainable fisheries and must be minimized.	90	88	7	54	22	43
4.14 Conflict exists within and among commercial, sport, and subsistence fisheries, and between fisheries and other consumptive and nonconsumptive resource users. Any resolution must consider the needs of all groups and the sustainability of the resource.	84	80	10	77	21	41
4.15 Real or perceived conflict may result from competition for food among fish and other species (e.g., birds and marine mammals). Any resolution must consider the integrity of the ecosystem as a whole.	Added concept		1	8	4	8
Issue 5: Manage for sustainable commercial, sport, and subsistence fisheries (Manage sustainable fisheries).	97	89	7	54	31	61
5.1 Fisheries management should involve diverse interests with a stake in fisheries or aquatic resources.	86	86	4	31	9	18
5.2 Fisheries management must consider the impacts of land-based actions, i.e., take a watershed-based approach. This will involve interactions among agencies and jurisdictions.	99	95	7	54	21	41
5.3 Fisheries managers must be involved with assessment; allocation; control of harvest (including enforcement); habitat conservation, restoration, and enhancement; stock conservation, restoration, and enhancement; and public education, including ethical angling.	97	88	7	54	26	51
5.4 Where appropriate, fisheries managers should make anglers and other consumers aware of alternate species to reduce the pressure on popular commercial and sport fish; e.g., encourage anglers to engage in diverse fishing opportunities.	63	60	3	23	6	12
Issue 6: Promote resource stewardship (Stewardship).	97	100	10	77	40	78
6.1 Anglers and nonanglers should understand that they have a vested interest in the conservation, restoration, and enhancement of aquatic resources.	93	97	6	46	21	41
6.2 Anglers and nonanglers must understand their rights, privileges, and responsibilities; i.e., they should be made aware of methods to personally help protect and/or improve the resource and have the opportunity to practice and apply them. Programs that teach natural resources ethics and skills are important to this effort.	88	91	6	46	31	61
6.3 Anglers and nonanglers must understand and respect the resource, the regulations, and the rights of others, including anglers, property owners, and the nonfishing public.	88	92	3	23	21	41
6.4 Anglers must be aware of and practice proper release-and-harvest techniques.	87	82	5	38	22	43
6.5 Anglers must be aware of their potential role in the dispersal of exotics and the transmission of disease, and take steps to avoid contributing to these problems.	Added concept		1	8	6	12
6.6 Anglers should be encouraged to enjoy the experience of fishing as well as the act of actually catching fish.	82	78	2	15	4	8

Table 2 continued.

Fisheries education issues and concepts	Reflects the AFS's position (n=65)	Should be addressed by fisheries education (n=65)	Issues and concepts covered by 13 secondary		all 51 materials	
	% strongly agree or agree		n	%	n	%
Issue 7: Promote responsible recreational fishing (Fishing).	84	92	7	54	25	49
7.1 Fishing is a positive and acceptable recreational activity for males and females of all races, ages, socioeconomic status, and physical and mental abilities.	92	94	4	31	12	24
7.2 The benefits of fishing vary from person to person. Some people enjoy the relaxation and beauty of the surroundings; some enjoy the competition; some fish to put food on the table. All forms are considered acceptable as long as the anglers' actions sustain the resource, respect others, and are within the law.	90	86	6	46	17	33
7.3 Anglers should understand the variety of equipment and tackle they may choose from and effectively use them.	56	61	3	23	16	31
7.4 Fishing safety is important to anglers and those around them.	83	89	3	23	18	35
7.5 Anglers must be front-line stewards with a vested interest in aquatic resource conservation, restoration, and enhancement.	84	88	2	15	9	18
7.6 Maintaining and increasing the number of responsible anglers can help fund management of the fisheries resource. In the United States, anglers provide funding for the management of fisheries resources through licenses and the Wallop-Breaux excise tax.	81	61	3	23	9	18
7.7 Materials address beginning angling techniques, intermediate angling techniques, advanced angling techniques, and specific species techniques.	57	64	3	23	17	33
Issue 8: Develop an awareness of fisheries as a profession and help prepare youth for careers in this profession (Careers).	98	96	6	46	17	33
8.1 Fisheries and aquatic sciences, together with economics and other social sciences, provide the basis for managing sustainable aquatic resources.	93	94	2	15	7	14
8.2 Fisheries professionals are a credible and reliable source of scientific and technical information concerning conservation and management of fisheries and aquatic resources.	93	92	4	31	9	18
8.3 A variety of fisheries and aquatic management and conservation careers exists. The fields of fisheries science, aquatic conservation, and management provide opportunities for motivated, scientifically prepared, and service-oriented people from diverse backgrounds.	89	85	5	38	13	26
8.4 Preparation for a career in fisheries and aquatic science includes a sound understanding of math and the sciences; professionals also should be well-rounded, with education and experiences in such areas as economics, law, communications, social sciences, and resource management. Fisheries professionals are committed to lifelong learning through continuing education programs designed to increase understanding of ecosystem management.	95	88	3	23	8	16

(from page 25)

simply serve as reference or support material; and (4) be at least 10 pages long (e.g., not simply a brochure or single activity). In addition, any video must have support material that met criteria (1) through (4). Fifty-four of more than 70 resources were finally selected for review. These materials came from local, state, regional, and federal or national agencies/ministries, organizations, and groups in Canada and the United States.

Next, one of the authors of this paper reviewed the 54 materials to determine their fisheries education content and various other characteristics (Crook and Zint 1998). Ideally, we would have liked more than one reviewer to enhance the reliability of the assessment of each material.

That is, multiple reviewers could examine materials independently and then come together to agree on a combined assessment for each resource (e.g., Pomerantz 1991; North American Association for Environmental Education 1997, World Wildlife Fund 1998). However, such an indepth review was not feasible because of the Committee's limited time and financial resources. Instead, Committee members initially compared assessments of a sample of materials with that of the reviewer's. This exercise provided the reviewer with a benchmark from which to proceed.

In light of the methods described, the Committee notes some limitations. First, the fisheries education framework used to review the materials includes issues and concepts important to AFS but may not address those viewed as significant by others. Second, the Committee is aware that additional valuable instructional resources that were not identified as part of this assessment likely exist. Last, the Committee fully supports the results of the single reviewer's assessment but acknowledges that the use of multiple reviewers may have yielded different results in some cases.

Results and Discussion

By the time the review of the 54 selected materials was completed, and reports were prepared, 3 of these materials were no longer available, so their results were excluded. Individual descriptions and results for each of the remaining 51 materials can be found in the user-friendly publication, *Guide to Fisheries Education Resources for Grades K–12* (Crook and Zint 1998). Table 2 summarizes the combined results of the content review of the remaining 51 materials. It is important to evaluate the results in Table 2 in terms of the concepts covered because that is how coverage of the issues was determined. In addition, Table 2 shows presence or absence of coverage and, therefore, cannot indicate differences in the depth of coverage.

Coverage of Issues and Concepts

Overall, this needs assessment revealed that most concepts under Issue 2 (Pollution) and Issue 7 (Fishing) received good coverage. Most concepts under Issues 1 (Habitat) and 5 (Manage fisheries) had reasonable coverage. Coverage of Issue 4 (Build sustainable fisheries) was mixed, with only some of the concepts addressed reasonably well. In contrast, Issue 3 (Biodiversity) had limited coverage. The remaining issues, 6 (Stewardship) and 8 (Careers), were covered somewhat better than 3 (Biodiversity) and 4 (Build sustainable fisheries) but not as well as the rest.

Most of the reviewed materials jump from "what's wrong" to "what you can do" without explaining "why you should care."

What are some of the gaps in coverage by issue? One important gap relates to the rehabilitation of fisheries through the reintroduction of native species (1.7). Materials don't take advantage of opportunities to use success stories to illustrate the gains that have been made in rehabilitating and protecting aquatic habitats and fisheries. Such "good-news" stories can promote fisheries management successes and, more importantly, can inform and encourage changes toward more environmentally responsible behaviors (DeYoung and Monroe 1996). In addition, the concept of critical habitat (1.4–1.6) is not adequately addressed. The reviewed materials generally describe fish habitat types, but these are rarely linked to important life stages or processes.

Issue 2 (Pollution) had no critical gaps, and several materials almost exclusively cover concerns related to solid waste and litter (2.3).

In contrast, coverage of Issue 3 (Biodiversity) is limited. Only one document (*Lake Effects: The Lake Superior Curriculum Guide*) covers five of the six biodiversity concepts included in the framework. Many materials address habitat and endangered species losses, introductions of exotic species, and other changes that can affect biodiversity, but few or no explicit ties to biodiversity are made when these topics are raised. Additional evidence of a lack of materials devoted to biodiversity in a fisheries context is provided by a recent review of 47 biodiversity resources for kindergarten through twelfth grade that includes no fisheries-oriented and only eight aquatic/marine-oriented materials (World Wildlife Fund 1998).

Issue 4 (Build sustainable fisheries) has a broad range of concepts and, therefore, possibly more mixed coverage than any of the other issues. Many of the concepts under this issue seem to deserve more attention, including the social impacts of fisheries closures (4.2); global pressures on fisheries (4.3); the influence of harvest gear selection (4.4); techniques and effort related to the sustainability of commercial and recreational fisheries (4.5); or bycatch (4.12). Other such concepts include the positive and negative (e.g., potential genetic changes) contributions of stocking (4.6) and aquaculture (4.9), the importance of enforcing legislation to sustain fisheries (4.10), and promotion of public concern about overharvesting (4.11). Of particular

Table 3 shows the audiences for which the 51 reviewed materials are identified as appropriate.

Audiences	n	%[a]
Preschool	0	0
Kindergarten–third or fourth grade	3	6
Kindergarten–sixth grade	6	12
Fourth–eighth or ninth grade	10	20
Seventh–eighth or ninth grade	3	6
Kindergarten–twelfth grade	5	10
Fourth–twelfth grade	6	12
Seventh–twelfth grade	9	18
Tenth–twelfth grade	1	2
College/university	4	8
Adult/general	8	16
None recommended or established	1	2

[a] Percents do not total 100% because each material can be appropriate for multiple audiences.

note is the absence of coverage about conflicts involving commercial, sport, and subsistence fisheries (4.14).

Issue 5 (Manage fisheries) receives reasonable coverage overall. However, the management of fisheries is rarely explained from an agency perspective. More specifically, there is little discussion of the value or need for fisheries management by watershed (5.2) or on alternative species as a means to reduce pressure on popular fisheries (5.4).

The most significant gap under Issue 6 (Stewardship) is that the materials do not stress *why* anglers and nonanglers need to be stewards of aquatic resources (6.1, 6.3). Most of the reviewed materials jump from "what's wrong" to "what you can do" without explaining "why you should care." Another important gap under this issue relates to

few...of the reviewed materials focus on global or marine fisheries, include multicultural perspectives, and target kindergarten to third grade and ninth to twelfth-grade levels.

anglers' potential role in dispersing exotic species (6.5). Content related to exotic species generally does not address bait bucket introductions, transfer by fishing boats or other means, through which anglers may contribute to exotic species introductions.

Issue 7 (Fishing) is covered well with the exception of the role that anglers should play as stewards of aquatic resources (7.5). This is of special concern in light of the relatively low coverage of two related concepts addressing anglers' and nonanglers' vested interest in (6.1), and responsibilities toward, aquatic resources (6.3). These results are consistent with those for aquatic resources education in general. Like fisheries education materials, broader aquatic resources education programs lack an emphasis on anglers as stewards (Thieme and DiCamillo 1994). The role anglers play in the conservation, restoration, and enhancement of fisheries and other aquatic resources seems especially deserving of more attention in education programs given the growing animal rights movement (Armitage 1996).

Issue 8 (Careers) receives acceptable coverage overall, and materials do a good job addressing the types of employment opportunities available. However, information needed to prepare high school students for college programs in fisheries is missing. Possibly, materials for college preparation such as those available to career counselors provide this information, but they were not reviewed as part of this needs assessment.

Overall, it is important to note that few (n=17, 33%) of the reviewed materials have marine-related content. That is, few materials include marine (i.e., saltwater as opposed to freshwater) fisheries examples or discuss global marine fisheries concerns or conflicts. Moreover, only seven of these marine-related materials contain a significant fisheries component, and they either focus on specific concepts (e.g., *Seals, Fish and You*—4.14, 4.15) or regions (e.g., *Fish and Fisheries*—Pacific Northwest). In addition, only one of the reviewed materials is dedicated to a First Nations/Native American perspective (*Early Fishing Peoples of Puget Sound*), and it focuses on the history of a subsistence fishery. Generally, there is a lack of multicultural materials that provide a range of cultural perspectives on fish, fishing, and fisheries management.

Grade-specific Concerns

Given the needs of children at various ages, we also decided to examine how the content of materials differed by grade level. Notably, the review identified only three kindergarten to third-grade materials that met the selection criteria. Of these materials, one is peripherally related to fisheries issues (*Lake Erie ...*); one has a regional focus (*Salmonids in the Classroom-Primary*); and the other one is mostly a "how-to-fish" booklet (*Ready, Set...Go Fishing!*). The review also showed that although many materials purport to cover a broad range of grades (i.e., fourth to twelfth) within particular activities or lessons, most fall in the fourth- to eight-grade range, and only 13 (26%) qualify as "dedicated" secondary (seventh and up) materials (Table 3).

With a few exceptions, these 13 secondary materials provide coverage similar to the rest of the materials. Exceptions for secondary materials include more coverage of Issue 5 (Manage fisheries) and two concepts under Issue 7 (Fishing) related to actual fishing knowledge and skill. Surprisingly, coverage of Issue 8 (Careers) was only slightly better for secondary materials. Also, only one of the secondary materials covers the recommended fisheries issues from a national or continental perspective (*Aquatic Resources Education Curriculum*); the rest are set in regional or provincial/state contexts or are highly focused.

Secondary materials that do a good job covering particular concepts or issues include *Decisionmaking: The Chesapeake Bay*, a regional document that highlights resource conflicts (4.14), habitat issues (particularly 1.5), and the effects of pollution (Issue 2); *Fish Banks, Ltd.*, a

Table 4 shows the topics the 51 reviewed materials have as their emphases.

Emphases	n	%[a]
Environmental issues	26	51
Ecology/ecosystems	23	45
Recreation/fishing	15	29
Habitat	14	27
Biology	13	26
Animals	12	24
Fisheries	12	24
Management/regulations	11	22
Water science	5	10
Plants	3	6
Careers	1	2
Recreation/general	1	2

[a] Percents do not total 100% because each material can have multiple emphases.

Table 5 shows the subjects addressed within the 51 reviewed materials.

Subject areas	n	%[a]
Science	44	86
Environmental studies	38	75
Social studies	31	61
Math	27	53
Language arts	26	51
Art	22	43
Physical education	20	39
Music	11	22
Health	4	8
Geography	2	4
History	1	2

[a] Percents do not total 100% because each material can address multiple subject areas.

Table 6 shows the instructional approaches suggested by the 51 reviewed materials.

Instructional approaches	n	%[a]
Activities	42	82
Discussion/debate	39	77
Research (field)	32	63
Demonstration/observation	30	59
Involvement in issues:	(28)	(55)
Local	17	33
State/provincial	6	12
Regional	1	2
National	1	2
International	3	6
Role-play/drama	28	55
Experiment	17	33
Presentations	17	33
Games/competition	15	29
Inquiry-based	12	24
Simulations	8	16
Cooperative learning	7	14
Problem solving	6	12
Peer teaching	4	8
Small group	4	8
Case studies	(3)	(6)
Local	2	4
State	1	2
Drama	3	6
Guided imagery	3	6
Decision-making	2	4
(Use of) local experts/mentoring	2	4

[a] Percents do not total 100% because each material can recommend multiple instructional approaches.

computer-assisted simulation that highlights the reasons for and results of overfishing (4.7) and covers all of Issue 4 (Build sustainable fisheries) well; *Fish Ways (Intermediate/Secondary)*, an Ontario-based program that covers Issues 4 (Build sustainable fisheries), and 5 (Manage fisheries) well and is noteworthy because of plans to apply it to the rest of Canada and the northern United States; *Life of the Lakes*, a Great Lakes-focused material that gives balanced coverage to most issues, covering Issues 4 (Build sustainable fisheries) and 5 (Manage fisheries) particularly well; and *Seals, Fish, and You*, a material that focuses on the interactions between seals and commercially important fish stocks, and does an excellent job covering fisheries conflicts (4.14., 4.15) that receive limited attention by other materials.

Other Important Characteristics

This needs assessment focused on identifying gaps in the fisheries education content of the selected materials. However, several other characteristics of the materials also were distinguished as important in helping fisheries professionals and educators select resources that can best meet their needs. These characteristics included whether educators can address the three fisheries education goals with these materials; the appropriateness of the materials for different subjects, grade levels, and geographic areas; the resources' recommended instructional formats and approaches; and the support materials they provide.

Regarding the three fisheries education goals (Table 1), the review suggests that many materials can help educators boost awareness and understanding (n=46, 90%) and can promote positive attitudes and values (n=43, 84%). Fewer materials suggest skills or opportunities for taking and evaluating actions to solve fisheries-related problems (n=34, 67%). One explanation for the more-limited inclusion of relevant action components may be that only a few materials are designed strictly for high school students (Table 3), where such a focus may be viewed as more appropriate than for the middle school youngsters (targeted by the bulk of the reviewed materials). Another explanation may be that many reviewed materials emphasize environmental issues or ecology and ecosystems, not fish, fisheries, or fishing *per se* (Table 4).

The review also found that materials are appropriate for various subjects and grade levels but that most target science instruction (Table 5) for fourth to eighth grades (Table 3). These findings are not surprising in that formal environmental education tends to be infused in science classrooms (Disinger 1987; Simmons 1989), and environmental education materials are generally designed for the middle-school level (J. F. Disinger, Ohio State University, pers. comm.; W. Stapp, University of Michigan, pers. comm.). Furthermore, the reviewed materials can be used in a variety of geographic locations. Many materials are general enough to be applicable to Canada, the United States, and possibly other countries (n=32, 63%); also most provide regional (n=29, 57%) and provincial/state (n=41, 80%) examples. Because the issues described in the materials tend to be similar across Canada and the United States (although the fisheries and stakeholders may differ), most materials should be adaptable to local conditions by using regionally relevant species as examples.

In addition to their applicability to a range of subjects, grade levels, and geographic areas, the materials offer flexibility in terms of the recommended instructional formats

and approaches. Although most materials are designed for formal educators (n=42, 82%), many also target nonformal settings (n=19, 37%). For both settings, a mix of indoor/outdoor environments (n=47, 92%/n=31, 61%) and activity/seatwork-based lessons (n=40, 78%/n=39, 77%) are suggested. Instructors also are encouraged to use aquatic sites (n=30, 59%), aquaria (n=14, 27%), fishing (n=13, 26%), and field trips (n=3, 6%) to enhance their fisheries education efforts.

Among instructional approaches, the use of activities is the most popular. However, some materials also encourage instructors to use approaches consistent with issue analysis and action research practiced in environmental education (Bardwell et al. 1994). These approaches help students learn about fisheries issues through independent research, discussion and role play of stakeholder viewpoints, and action to help improve fisheries.

Notably few materials recommend the use of local experts and mentors as important teaching resources (Table 6), possibly because fisheries professionals have too many other duties and too little administrative support to assist with youth fisheries education. Still, many local fisheries professionals recognize that they should work with teachers and be role models for students, and some volunteer personal time accordingly. It is important that administrators encourage fisheries professionals to incorporate education into their daily work routines and provide them with necessary training and resources. Long-term mentoring by natural resource professionals may develop youth with a stronger commitment to the environment (Matthews and Riley 1995) and may encourage them to pursue natural resource careers.

The lack of "leading-edge-process" (n=4, 8%) materials that go beyond the "current" (n=40, 78%) popular, activity-based Project WILD-style approach also should be noted here. For example, only a few resources encourage the use of the Internet or innovative cooperative learning techniques. This may be because few of the reviewed materials were published recently (median 1991; range 1978–1997).

Most reviewed materials are current but not leading-edge in content and process.

Finally, given the limited time fisheries professionals and educators are likely to have to prepare and implement fisheries education lessons, resources should include appropriate support materials. Fortunately, the review shows that most materials provide manuals (n=44, 86%), background materials (n=42, 82%), lesson plans (n=42, 82%), and additional references (n=34, 67%) for instructors as well as worksheets for students (n=36, 71%). Moreover, many (n=32, 63%) materials are available at reasonable cost (mean=$22, range $2–$100), and some are provided at a varying charge (n=4, 8%) or are free to teachers (n=15, 29%) who participate in a training workshop (n=7, 14%). This is appropriate because disseminating environmental education materials through workshops, compared with giving them away for free without training, results in greater use of resources by instructors (Mayer and Fortner 1987).

Table 7 lists the key content areas for which additional materials are needed.

- Alternative species for commercial, sport, and subsistence fisheries: Are they keys to sustainability?
- Aquaculture: advantages and limits
- Commercial, sport, subsistence fisheries conflicts
- Fisheries and biodiversity
- Fisheries and critical habitats
- Fisheries and watersheds
- Fisheries as a career (especially aimed at counselors)
- Global trends and fisheries issues
- Harvest: effects of gear selection, techniques and effort, bycatch (for commercial, sport, subsistence fisheries)
- Introduced species: boon and bane
- Sharing the resource: fisheries and interspecific competition
- Stocking: advantages and limits
- Subsistence fishing and aboriginal rights

Recommendations

The Committee has developed the following recommendations on the basis of this review:

(1) Results of this needs assessment should be widely disseminated to fisheries professionals and interested educators. The information summarized in the user-friendly guide will help these individuals select appropriate instructional resources. Awareness of the guide should be generated by announcing its availability on the Internet and in publications of fisheries, education, and other groups.

(2) The guide should be updated in one to two years and at three- to four-year intervals thereafter. Users of the guide and other individuals should be contacted and encouraged to identify fisheries education materials and programs for future editions; this information should be sent to the AFS Education Section Youth Education Committee. Information on additional resources also should be collected through the Internet and more formal processes, including interviews, focus groups, and/or mail questionnaires targeted at kindergarten through twelfth-grade teachers, aquatic resource educators (including marine educators), fisheries professionals, and others.

(3) Most reviewed materials are current but not leading-edge in content and process. This has not gone unnoticed by curriculum developers, many of whom are revising their resources. Developers should refer to the fisheries education framework for important issues and concepts to include and should look to fisheries scientists to provide insight into these areas. In addition, developers should look to education experts for the latest in innovative teaching techniques and learning tools and follow guidelines for producing quality education materials (e.g., North American Association for Environmental Education 1996).

(4) New materials should be developed to fill the content gaps identified by this needs assessment (Table 7), and

if they focus on global or marine fisheries, include multicultural perspectives and target kindergarten to third-grade and ninth- to twelfth-grade levels. Development of such new materials should actively involve fisheries professionals and formal and nonformal educators.

(5) A need exists to support existing fisheries education materials and efforts. Many organizations indicated they are unable to obtain funding to revise and improve popular resources or to publish additional copies. Rather than "reinventing the wheel," funding should be provided to improve or "grease" existing wheels. This assistance would be best used for updating, improving, reprinting, promoting, and disseminating existing materials.

(6) Finally, many individuals and groups are interested in fisheries education for youth but have not developed beneficial partnerships. Potential partners include but are not limited to individuals such as fisheries professionals, formal and nonformal educators, curriculum developers, university faculty, and extension personnel, and anglers and fishers; agencies such as state natural resource and education departments and the National Marine Fisheries Service, National Sea Grant College Program, and U.S. Fish and Wildlife Service; industry groups such as the American Sportfishing Association and the Canadian National Sportfishing Foundation; nongovernmental organizations such as the Canadian Wildlife Federation, National Wildlife Federation, and Trout Unlimited; and foundations such as the National Fish and Wildlife Foundation. Affiliated professional groups (e.g., AFS, International Association of Fish and Wildlife Agencies, Aquatic Resources Education Association, National Marine Educators Association, National Science Teachers Association, and North American Association for Environmental Education) lend themselves to developing and strengthening linkages among these parties and, thus, can and should play important roles in improving fisheries education materials for youth.

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