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A Large Marine Ecosystem Voluntary Environmental Management System Approach to Fisheries Practices

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Acronyms

AAAS	=	American Association for the Advancement of Science
CEQ	=	(White House) Council on Environmental Quality
ECPA	=	East Coast Pelagic Association
EEZ	=	exclusive economic zone
EIA	=	environmental impact assessment/analysis
EPA	=	(US) Environmental Protection Agency
FAO	=	(UN) Food and Agricultural Organization
FDA	=	(US) Food and Drug Administration
FMP	=	fishery management plan
GIS	=	geographical information system
GMRI	=	Gulf of Maine Research Institute
GPS	=	global positioning system
HACCP	=	hazard analysis critical control points
ISO	=	International Organization for Standardization
ITQ	=	individual transferable quota
LME	=	large marine ecosystem
MOU	=	memorandum of understanding
MSC	=	Marine Stewardship Council
NEFMC	=	New England Fishery Management Council
NEPA	=	(US) National Environmental Policy Act
NMFS	=	National Marine Fisheries Service
OMB	=	(White House) Office of Management and Budget
QMS	=	quality management system
S-K	=	Saltonstall-Kennedy Act
TAC	=	total allowable catch
UN	=	United Nations
UNEP	=	United Nations Environmental Programme
VEMS	=	voluntary environmental management system
VMS	=	vessel monitoring system
WSSD	=	World Summit on Sustainable Development
WWF	=	World Wide Fund for Nature

ABSTRACT

This study addresses interdisciplinary aspects of fisheries sustainability as a part of the large marine ecosystem (LME) modular approach. Consideration is given to consensus-based voluntary environmental management systems (VEMS) as an adaptive management aspect of fishing practices being integral strategic parts of marine ecosystems. A VEMS is a unique means or tool for managing the impacts of a fisheries enterprise's activities on the marine environment. For sustainable planning and implementing environmental protection measures, the VEMS provides a structured approach. A VEMS integrates environmental management quality at various scales into an organization's everyday operations as well as its long-term planning.

The VEMS is an important "ecosystem consideration" component of the LME approach as it is intended to lead toward improved valuation assessments and movement to sustainability of vulnerable resources. This document presents a VEMS strategy as a prospective best practice indicator in the fish and fisheries, socio-economic, and governance modules of the LME paradigm (see *http://www.edc.uri.edu/lme*). Prospective property rights regimes are considered as performance-based regulations that restrict open access to commercial fishery resources but can accommodate the VEMS approach. The fisheries practice VEMS, found in this study, has a geographic focus on the Northeast U.S. Continental Shelf LME but is applicable to other domestic and/or international locales and it is meant to promote dialogue on VEMS being a scientifically based (or best available science standard see: NRC 2004a) tool for ecosystem-oriented management of living marine resources.

INTRODUCTION

The ISO 14001 is a known voluntary international standard that establishes the requirements for a VEMS that emphasizes an organization's continuous improvement in environmental management quality and protection. Thus, the objective is for an entity engaged in fishing practices to constitute a VEMS that is integrated with its operations. An ISO 14000 series voluntary environmental management system (VEMS) is portrayed in this document as a performance-based measure that can be utilized around the world and as a best available science-based procedure for protecting the marine environment. Hanna (2002 p. 4) hypothesizes that the "existence of property rights (in fisheries) would allow the focus to shift toward performance-based regulation, where the right to fish depends on certification of meeting specified conditions." Taken literally, a review and synthesis of the science literature finds that Hanna's hypothesis above which would include "dedicated access privileges" in a U.S. fishery is capable of fostering performance towards sustainable ecosystem-approaches to fisheries, that is, to an ISO 14001 standard voluntary environmental management system (VEMS).

Gober (2000 p. 8) points out "modern synthesis is organized around ideas, concepts and theories. It emphasizes discovering strategic connections…," "it may involve linking already discovered ideas in innovative ways, in grappling with large and complicated human and natural systems, and in looking for analogies in seemingly unconnected fields." Thus, it is proffered that the application of voluntary environmental management systems (VEMS) as outlined here will lead toward continuous improvement in large marine ecosystem environmental quality as a science policy tool for fostering stakeholder participation toward sustaining living marine resources. The document commences with an overview of what a voluntary VEMS approach to ecosystem sustainability encompasses. From there the focus is on "legitimacy" of specific VEMS protocols for use in living marine resource sustainability principally in the United States prior to elaboration on the international VEMS standard known as an ISO 14001.

Case examples are provided in Appendix One, in relation to "market forces" in American fisheries management, including contemporary herring-haddock interactions in the Northeast U.S. Continental Shelf Large Marine Ecosystem. The Large Marine Ecosystem (LME) paradigm is briefly reviewed as an adaptive stewardship strategy in Appendix Two, followed by a short discussion on the Marine Stewardship Council as another "new" VEMS in fisheries. An approach to "certification" in VEMS is given in Appendix Three. The manuscript contains figures and tables that illustrate and highlight specific key points and concepts for the reader.

One suggestion for integrating marine species management into a workable ecosystem-oriented voluntary environmental management system (VEMS), can include partnering to maximize the potential for achieving objectives (see Figure 1). To enhance global, regional, or local accountability, a marine life management system should recognize and address the overall ecosystem (see: Sherman & Duda 1999a&b; von Zharen 1998 p. 106). Dobson et al., (2005 p. 488) refer to "human dimensions" "as the study and practice of human values related to natural resources, how those values impact and are manifested in management, and how humans affect or are affected by natural resources management decisions" (see also: Hennessey and Sutinen, 2005). "Challenges of integrating ecological and human dimensions of management remain as important today as they were forty years ago" (Dobson et al., 2005 p. 487). The human dimension is at the very core of the fishing and seafood industries (Kaplan and McCay, 2004 p. 258). It is also of note that according to Daily et al., (2000 p. 396) "in a democratic society, values used in social decision-making ought to be derived from those held by its individual citizens and ought not be imposed by the state." The ISO 14000 family of standards is depicted and elaborated herein as a tool to foster voluntary and sustainable human-environment interactions.

WHAT IS AN ISO 14000 APPROACH TO MARINE ECOSYSTEM SUSTAINABILITY?

The International Organization for Standardization ISO 14000 series is a recognizable developing flexible methodology for organizations seeking to incorporate internationally and/or domestic defensible environmental management policy into their marine business operations. The ISO is a Geneva-based registered non-governmental, international organization and facilitator of international standards in industrial and environmental practice. Its members are governmental standardization organizations from 120 nations, including the United States. Motivated to foster world trade after World War II, it was created in 1946 to initially address electronic, communication, trade, and manufacturing standards. Traditionally, ISO standards are embraced on a voluntary basis, yet select countries have regularly adopted them, thereby making them obligatory (Sproul, 1998a and 1998b p. 141).

From a historical perspective Sproul (1998b p. 141) relates that in the early 1980's ISO branched out to develop total quality management standards and life cycle analysis. In 1987, the International Organization for Standardization (ISO) issued the ISO 9000 series standards for business management and manufacturing (Eccleston, 2003 p. 61; see

also Benezech et al., 2001). Concern for environmental quality eventually led ISO to focus and negotiate on developing similar standards for a transparent voluntary environmental management system (VEMS) that could be used internationally. Thus building on the ISO 9000 model, the initial generic standards governing the ISO 14000 series VEMS were adopted and published in September of 1996. Analogous to its sibling ISO 9000, the ISO 14000 series describes management procedures rather than specific environmental performance standards (Eccleston, 2003 p. 61). Aspects of ISO 9000 have subsequently been incorporated into international policy to "facilitate trade and remove…barriers" (Sproul, 1998b p. 141). In 1992, the ISO Technical Board authorized establishment of Technical Committee number 207 (TC 207). This bureau whose secretariat is in Ottawa with the Canadian Standards Association, was tasked with the responsibility to oversee and coordinate the diversity of activity associated with international voluntary environmental management systems (VEMS) development. In 1993, the ISO established a Technical Committee (TC207) that consisted of representatives from participating nations the world over, to develop and produce a set of unified, voluntary standards for environmental management that could be accepted and implemented worldwide (Quazi et al., 2001 p. 526). The ISO 14000 standard has been developed to help any organization (entity) in any country to meet the goal of "sustainable development" and environmental friendliness (Quazi et al., 2001 p. 527), important ingredients in LME-oriented fisheries science policy. The ISO has accumulated extensive inter-governmental and ministerial networking at the national policy development level and has considerable historical international standardization experience. Therefore, many international researchers and also American policy makers (see: Connaughton, 2002a; and 2001) suggest or advocate an ISO 14000 protocol ought to be pursued (see later).

The ISO 14000 standards are international voluntary consensus standards (Quazi et al., 2001 p. 526). These industrial practice standards were developed by the International Organization for Standardization (ISO), located in Geneva, Switzerland. The goal of the ISO is to develop standards on a worldwide basis to allow commerce to transcend national boundaries without creating trade barriers (Quazi et al., 2001 p. 526). This is a goal that complements and can be practiced within the internationally recognized large marine ecosystem (LME) delineated areas whose marine living resources are typically marketed and traded via negotiated international agreements, since international trade in seafood is now valued at about U.S. $60 billion annually (Mansfield, 2003 p. 1). The standards are process oriented they do not in and of themselves impose or establish goals or limits. Instead, they establish voluntary environmental management system guidelines or guidance that help organizations (entities) ensure compliance with customer, industry or regulatory limits and/or requirements. They can be considered "rooted in the concept of ecosystem sustainability" (see Baragne, 2003 p. 196) and criterion for "best practices." (see: e.g. Sainsbury et al., 2000 p. 732). According to von Zharen (1998 p. 85), she notes that the VEMS must have public and prospectively global support in order for comprehensive measures to improve these efforts. This would include support for international collaboration in marine scientific research and the development of "best practices." (e.g., Sainsbury et al., 2000; Sainsbury and Sumaila, 2003; Gable, 2004).

According to Sainsbury et al., (2000 p. 732), fishery management is "implemented at the operational level through management plans, administrative regulations, and the decisions of individual managers or management bodies." Choices and tradeoffs often need to be made concerning which of several alternative management actions provides the best social and environmental compromise among conflicting objectives. Therefore it's necessary to be able to forecast the likely consequences of prospective management actions to the targeted objectives. This may entail answering questions such as: what specific outcomes are intended by the management action?; what information is needed to support management decisions?; and how would success or failure be measured and detected (Sainsbury, et al., 2000 p. 732)?

Broad policy goals are linked to individual management actions at the operational level, and through operational management strategies. Sainsbury et al., (2000 p. 732; Figures 2, 3) suggests that the general framework for operational management strategies is described in many standards, such as the International Standards Organization ISO 14000 standards for environmental management systems. Accordingly, they suggest the ISO 14000 and other such frameworks emphasize the combination of: A) synoptically evaluating the performance of the management system as a whole (not just isolated parts); B) specifying measurable targets and performance measures that relate to the objectives; C) monitoring the managed system; D) iterative and "feed-back" decision-making based on monitoring data e.g. "double loop analysis;" E) developing a procedure for implementing management decisions; and, F) evaluating organizational environmental performance.

"Development and evaluation of operational management strategies to achieve broadly stated management objectives is neither easy nor straightforward, although considerable progress has been achieved during the last two decades, at least for target species. The scientific methods for evaluating fishery-management strategies were advanced through 'adaptive management' mechanisms" (Sainsbury et al., 2000 p. 732 and references cited therein). It is noted that Jentoft (1998 p. 181) proffers that there is no "consensus as to what constitutes relevant knowledge and information in fisheries management. Neither is there any widespread agreement on goals or means."

The aims of the ISO 14000 series are to provide guidance for developing a comprehensive approach to environmental management and for standardizing some noteworthy and recognizable environmental tools of analysis such as (environmental) labeling and life cycle assessment appli-

cable to the fishing industry as a whole. Allison (2001, p. 945) writes that an ISO 14000 series VEMS is capable of addressing many of the necessary conditions for 'green chain' life cycle-oriented certification from production to disposal (see also Sproul, 1998a&b).

The standards are meant to be complementary to national regulatory regimes and are not intended to replace or duplicate a country's regulatory system (Quazi et al., 2001 p. 527). In effect, use of a VEMS is designed to demonstrate an organization's facilitation and knowledge of environmental sustainability commitments in a transparent documented manner. Thus, the ISO 14000 series VEMS traditionally consists of five principles as depicted in Figure 4.

The most commonly used framework for a VEMS is the one developed by the International Organization for Standardization (ISO) for the ISO 14001 standard. Established in 1996, this framework is the official international standard for a VEMS (EPA, 2005). The five main stages of a VEMS, as defined by the ISO 14001 standard are discussed below (see also Figure 4):

1. **Commitment and Policy**: top management (e.g. fisheries permit holder, boat captain, vessel owner, executive director of a fisheries organization) commits to environmental improvement and establishes an enterprise wide environmental policy with attainable objectives and goals. The policy thus becomes the foundation of the VEMS, and the benchmark for performance evaluation that occurs later.
2. **Planning**: by example, a fisheries organization first identifies environmental aspects of its operations. Environmental aspects are those items, such as indirect and regulatory bycatch, discards, highgrading, etc., which can have detrimental cascading impacts on the large marine ecosystem. In general, the organization then determines which aspects are significant by choosing criteria considered most important by the organization within the constraints of applicable prevailing legislation. For example, a fisheries organization may choose crew safety and health, environmental compliance, and cost as its criteria. Once significant environmental aspects are determined, an organization sets specified objectives and targets. An objective is an overall environmental goal (e.g. minimize bycatch and discards). A target is a detailed, quantified requirement that arises from the objectives (e.g. reduction of bycatch of groundfish by 25% by September 2006). The final part of the planning stage is devising an action plan for meeting the targets (e.g., Wu and Hunt, 2000). This includes designating (crew) responsibilities, establishing a schedule and timeline, and outlining clearly defined steps to meet the targets (EPA, 2005).
3. **Implementation**: an organization follows through with the action plan using the necessary resources (human, financial, etc.). An important component is organization – for instance crew training and awareness for all hands, or employees of a fish processing plant. Other steps in the implementation stage include documentation, following operating procedures, and setting up internal and external communication lines for interested stakeholders and consumers or publicly traded company shareholders. Then the enterprise using "best available scientific" methodology (see e.g. NRC 2004a) evaluates its environmental performance to see whether its objectives and targets are being met.
4. **Evaluation and Monitoring**: an organization monitors its operations to evaluate whether its targets are being met, if not, the organization takes appropriate adjustment corrective action (e.g. avoiding areas of juvenile fish or in-season spawning grounds; gear adjustments). Oftentimes for more efficiency the evaluation is performed by an independent accredited third party, that can lead toward "certification."
5. **Review**: top management reviews the results of the evaluation to see if the VEMS is functioning as designed. Management determines whether the original environmental policy is consistent with organizational values. The action plan is then revised to optimize the effectiveness of the VEMS. The review stage creates a double loop of analysis of continuous improvement and learning for an organization in a transparent fashion (see also Benezech et al., 2001; Figure 5). The cycle (i.e. "double-loop analysis") repeats, and continuous improvement occurs, all within a framework of adaptive management to government regulations and industry "best practices" (see e.g. Sainsbury et al., 2000; Sainsbury and Sumaila, 2003; Gable, 2004).

According to Eccleston and Smythe (2002 p. 2) one objective of the ISO 14000 VEMS series is to provide organizations with an internationally consistent system for controlling, measuring, and ultimately reducing the environmental impacts generated by their ongoing business operations. It may also help managers to better implement fisheries catch permitted or allocation mechanisms in a more environmentally sustainable manner. Without further specific elaboration here, by example, ISO 14001 specifications describe a multitude of elements that need to be contained in any VEMS that is to receive certification to International Organization for Standardization (ISO) standards.

Like its predecessor sibling, ISO 9000 life cycle standards, the 14000 series focuses on management standards, not on specific performance standards and procedures because these are left to individual countries or entities, that can adaptively apply them to their specific needs and environmental situation. This would work well in differentiated boreal, temperate, tropic, oceanic, and semi-enclosed LME's throughout the world. Unlike Environmental Impact Assessment/Analysis (EIA), the ISO 14001 VEMS protocol was designed specifically for competitive entity's (see also:

Hart, 1995) to adopt on a voluntary basis (Eccleston and Smythe 2002 p. 2).

According to Darnall (2001, p. 2) ISO 14001 is based on Shewhart's (1931) "plan, do, check, act" model towards achieving continuous improvement (see also Blackburn, 2004; Figure 6). Darnall emphasizes that by using this framework, organizations systematically take into consideration their environmental aspects and impacts. They do so, as depicted earlier, by taking into account five broad factors: an environmental policy, evaluation and goal setting, implementation, monitoring and corrective action procedures, and management review. By processing through each step of the cycle the aim (goal) of the organization (entity) is to achieve lower environmental impact of goods, products, services, or information, thus, providing for environmental sustainable ecosystem development. It is represented graphically as a circle or wheel (see Figure 4) because it involves repeating the same steps over and over in a continuous effort to improve operational processes. It is akin to "double loop analysis" that Olsen (1999; Olsen et al., 1998) subscribes to in integrated coastal area management (for suggested contents of an ecosystem area management plan for sustainable fisheries see Table 1). Organizations which certify to ISO 14001 typically would have independent external auditors review and verify their VEMS to make sure that it conforms to the five broad categorical factors (Darnall, 2001 p. 2).

At a more advanced level, ISO 14001 VEMSs have the potential to move organizations towards embracing, for example, seafood product stewardship principles and utilizing life-cycle cost analysis (Brown and Sylvia, 1994). In doing so, ISO 14001 may help firms to better scrutinize the environmental impact of their services, and develop closer working relationships with ownership and "crew," thus elevating and evaluating environmental concerns throughout the organization (Darnall, 2001 p. 3; Hart, 1995). If entities consider holistically all aspects of their organizational structure, this awareness may facilitate the prevention of shifting environmental harm from one subsystem to another or rather, one directed fishery to another non-permitted resource. Such management practices, however, require proficiencies in transferring knowledge and generating momentum among human capacity to proactively manage their environmental footprint. The example of alleviating incidental and regulatory bycatch and discards by fishing vessels is a prime statutory contemporary example (Powers, 2005; Hall and Mainprize, 2005). From the perspective of Jennings and Zandbergen (1995 pp. 1040 & 1041) they also require an ability to push environmental initiatives deep into the organization's "lessons learned psyche" to create congruence (harmony) across the strategic, structural and learning systems to foster and ensure ecosystem sustainability. These factors in combination assist business to achieve greater organizational efficiency (Hart, 1995 p.988) and are critical for achieving proactive environmental sustainability. They are also crucial in assisting organizations (firms) to maintain or gain competitive advantage (e.g. Hart, 1995 p. 987; Figure 7) especially in regulated industries such as fisheries where "dedicated access privileges" may become the 21st century norm in the United States (CEQ, 2004); what Hart (1995 p. 995) refers to as "preferred access" to important, but limited resources.

As many of those who follow the regulated fishing industry know, the U.S. National Environmental Policy Act (NEPA) regulations provide detailed requirements for performing a comprehensive analysis of direct, indirect, and cumulative environmental impacts (see e.g., Eccleston and Smythe 2002 p. 6; Boling, 2005). The ISO 14000 standards requires that a VEMS includes investigation of significant "environmental aspects," which are specific activities that affect the marine environment. Although these environmental aspects must be determined, rigorous evaluation of their resulting consequences or impacts on environmental resources is neither mandatory nor required especially in a scenario style command and control regulatory framework environment.

Eccleston and Smythe (2002 p. 8) proffer that in practice, however, there is no reason why Environmental Impact Assessment (EIA) and VEMS processes either could or should not proceed in tandem (see also Boling, 2005). The aim or goal being a properly integrated EIA/VEMS, to ensure that monitoring plans are effectively designed and executed. (Eccleston and Smythe 2002 p. 8). Monitoring is also a paramount tool in LME science policy to measure environmental conditions over time (see; e.g. Sherman, 1994; Sherman and Duda, 1999a & b). Integration of EIA/VEMS is especially appropriate where government decisions are required, and where government (or government-regulated) enterprises will carry out the operations. The EIA (e.g. Figure 8) can identify the kinds of significant impacts that a VEMS should address, and the VEMS can then ensure that adequate monitoring, reporting, and self-correcting take place in a transparent mode. (For another view of the EIA see Gray, 1999).

Eccleston (2003 p. 61) maintains that strong parallels exist between the scope, aims and objectives of adaptive management, the requirements of the U.S. National Environmental Policy Act (NEPA), and the specifications for implementing an ISO 14000-consistent VEMS (see Figures 9, 10). Seymour and Ridley (2005 p. 322) proffer that an ISO 14001 VEMS approach can be synergistically incorporated into an integrated catchment or watershed management protocol, which is in effect, the linked "landward" portion of large marine ecosystems.

Boling (2005 p. 10026) advises that a "VEMS is a policy and management approach that may be particularly applicable for adaptive management of actions subject to National Environmental Policy Act (NEPA) review" in the United States. Boling (2005 p. 10026) emphasizes that the "plan-do-check-act/continual improvement approach (see also Darnall, 2001 p. 2; Rondinelli and Vastag, 2000 p. 501) used by ISO 14001 and similar models has proven to be

effective as applied to environmental management" (see Figure 6). With regard to elements of VEMS and NEPA programs an ISO 14001 protocol "provides a credible framework for identifying and meeting the legal and other obligations that are established through the public process. It does not pretend to intrude upon authorities of government agencies to define goals for environmental performance." Thus, an ISO 14001 VEMS does not replace NEPA, but rather provides a systematic framework for effectively identifying and meeting NEPA obligations (Boling, 2005 p. 10026). Boling (2005 p. 10029) states that the ISO 14001 standard "requires that an organization establish and maintain procedures for taking action to mitigate any impacts caused, and for initiating and completing corrective and preventive action." The "plan, do, check, act" approach of ISO 14001 is intended to encourage organizations to integrate a VEMS into their normal every-day activities (Boling, 2005).

The ISO 14001 VEMSs are principled on a highly systematic framework that at a basic level focuses on various environmental strategies which minimize waste and prevent pollution (e.g. including fisheries driftnets i.e. ghost fishing; bycatch, discards and highgrading) (Darnall, 2001 p. 3). These strategies are people intensive, and depend upon concerted skill development through employee or "crew" involvement (e.g., Hart, 1995 p. 988) and work in teams (e.g., Hart, 1995 p. 989). They also rely on substantial internal organizational evaluation, monitoring, knowledge development, and operational factors (Darnall, 2001 p. 3, Hart, 1995). They are a "best practices" match for organizations (entities) with either fishery business operations or scientific study in large marine ecosystems (see: Sainsbury et. al., 2000 p. 732; Sainsbury and Sumaila, 2003; Gable, 2004). In effect, they fit well within the LME modular approach (see e.g. Figures 11, 12, 13; Sherman, 2005; Sherman and Duda, 1999 a&b) with a focus in the socio-economic, fish and fisheries, and governance modules.

According to Sproul, (1998a&b) an international organizational standard (ISO) framework ought to be utilized for developing broad principles of sustainable fishery certification, within which fishery specific specifications could be provided. He maintains that several standards for fisheries principles exist, for example, including the voluntary United Nations (UN) "Code of Conduct for Responsible Fisheries" (see: Garcia, 2000), and the UN Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks which entered into force in 2001 (Sproul, 1998b p. 140). The latter is an adjunct to the Third United Nations Conference on the Law of the Sea (UNCLOS, 1982). The "voluntary" United Nations based 1995 "Code of Conduct for Responsible Fisheries" and the International Standardization Organization (Geneva, Switzerland) ISO 14001 voluntary environmental management system (VEMS) protocol provide a baseline and standards "that are based on an inventory of what exists (in science, technology, experience and usual practices, etc.) in relation to some observations" (Benezech et al., 2001 p. 1396). It can be argued that the "Code of Conduct…" may be considered to be emerging international customary law (see Belsky, 1990; Belsky, 1985). To facilitate global large marine ecosystem (LME) acceptance and implementation of "sustainable fisheries (and aquaculture) principles," they ought to be framed within a broad purview of environmental management system standards (Sproul, 1998b p. 140).

LEGITIMACY FOR FOSTERING AN ISO 14000 SERIES PROTOCOL IN THE UNITED STATES AS WELL AS FOR USE WITHIN INTERNATIONAL LARGE MARINE ECOSYSTEMS (LMEs)

The movement from concept to an applied standard should stand the test of legitimacy. In the U.S., the presence of legitimacy is discussed by James L. Connaughton who is the present chairman of the U.S. Council on Environmental Quality (a bureau that coordinates federal environmental efforts in the development of environmental policies and initiatives). Connaughton (2002a p. 2) mentions the "U.S. government has been an ardent supporter and believer in the international standards process, and specifically, the ISO 14000 family of environmental standards." He emphasizes the "ISO 14000 series of standards … provides recognizable, transparent, and flexible models and tools for managing environmental issues. These international standards have been developed by consensus of a world-wide collection of experts, and allows us to operate effectively without having individual government entities create their own protocols and guidelines." Further, he reiterated that U.S. federal agencies must use existing international standards instead of creating their own requirements or standards because the National Technology Transfer and Advancement Act, (passed in March of 1996; Public Law 104-113) mandates that as policy (Connaughton 2002a; U.S. Congress, 1996 a&b).

Zwight (2004, p. 35) highlights that in the United States The National Technology Transfer and Advancement Act "requires that federal agencies adopt, where possible, technical standards developed by consensus organizations. The ISO 14000 series of environmental standards were developed through the consensus processes of the International Organization for Standardization and were adopted by the American National Standards Institute." "Environmental management systems' can provide a structure for effective adaptive management of natural resources and continual improvement of environmental performance. Environmental management systems' could help new science and information to be quickly integrated into the analytical base to

be used not only to account for broad management effects and natural events at the plan level but also to provide a refreshed and current base of information" to be used in connection with fishery planning where an "environmental management system approach has been endorsed by the White House Council on Environmental Quality (CEQ)" (Zwight, 2004 p. 33).

The National Technology Transfer and Advancement Act of 1995, which passed on March 7, 1996 (Public Law 104-113), codified requiring federal agencies to adopt and use standards developed by voluntary consensus standards bodies and to work closely with those organizations to ensure that the developed standards are consistent with agency needs and with Office of Management and Budget (OMB) Circular A-119 (House Report No. 104-390 Legislative History; Public Law 104-113 Section 12: Standards Conformity). OMB Circular A-119 was revised on February 10, 1998 to coincide with Public Law 104-113 of March 7, 1996. OMB Circular A-119 policy in Section 6 states "[A]ll federal agencies (or other establishment of the Federal Government) must use voluntary consensus standards in lieu of government unique standards in their government and regulatory activities except where inconsistent with law or otherwise impractical." Section 6(e) mentions "when properly conducted, standards development increase productivity and efficiency in government and industry (e.g. Bodal, 2003), expand opportunities for international trade, conserve resources, improve health and safety, and protect the environment." (U.S. Office of Management and Budget, 1998, see: http://www.whitehouse.gov/omb/circulars/a119/a119.html, online available May 14, 2005). von Zharen (1995 p. 12) highlights "there is today a seemingly unlimited potential for noncompliance with marine and coastal resources environmental regimes because these regimes are a patchwork of sometimes overlapping and contradictory law."

Early experience in the U.S. with voluntary environmental management systems (VEMS) was legally required for federal agencies via Presidential Executive Order 13148 of April, 2000 (Presidential Documents, 2000). The Order included tacit reference to ISO 14001 (see: Environmental Protection Agency 1996, – Code of Environmental Management Principles *Federal Register* Vol. No. 61 (201) at p. 54062, October 16, 1996)… "or use another alternative environmental management system, e.g. ISO 14001." Pilot initiatives posited through or by U.S. Environmental Protection Agency (EPA) indicated that this bureau encouraged use of VEMS, and ISO 14001 as "the predominant model, as the foundation tool for best management practice efforts" when organizations seek enhanced environmental performance through voluntary mechanisms (Connaughton, 2002a p. 3).

"The administration is committed to greening the government (Executive Order 13148 of April 21, 2000) and ensuring that Federal agencies do seek to minimize harm to the nation's natural resources. The Clean Marina program is an existing voluntary partnership between the Federal government, states, and private marinas that promote state certification of marinas that practice good environmental stewardship in areas such as pollution prevention and waste management;" it also may be applicable in recreational (forhire; party/charter) fisheries. Executive Order 13148 of April 21, 2000 (Greening the Government Through Leadership in Environmental Management) has as one of its goals (Part 2, Section 201) the development and implementation of environmental management systems. Part 4 Sec. 401 of said Order requires that "each agency shall conduct an agency-level environmental management system self assessment based on the Code of Environmental Management Principles for Federal Agencies developed by the Environmental Protection Agency (EPA) (61 *Federal Register* 54062, October 16, 1996) and/or another appropriate environmental management system framework." The Code of Environmental Management Principles by the EPA (*Federal Register* Vol. 61, No. 201 pp. 54061-54066, October 16, 1996) specifically makes reference to ISO 14001 voluntary environmental management system (VEMS) as another alternative environmental management system that is endorsed to be used[1,2,3,4,5] (see also Figure 5).

Connaughton (2002a p. 4) posits the viewpoint that use of the ISO 14000 family of standards including the "environmental performance evaluation guidance documents will be very helpful in our effort to develop relevant environmental indicators and relevant metrics." Because " relevant" marine environmental indicators (metrics) exist within the modular large marine ecosystem (LME) framework used throughout the globe and, since autumn 2004 the United Nations Environmental Programme (UNEP) Regional Seas Programme is officially "linked with Large Marine Ecosystems assessment and management," use of an ISO 14001 VEMS is compatible as part of this new partnership (see e.g. Connaughton 2002a; UNEP, 2004; Laffoley et al., 2004; Sherman, 2005).

Under Presidential Executive Order 13366 of December 17, 2004 – Committee on Ocean Policy – functions of the committee provides for "voluntary regional approaches with respect to ocean-related matters (including natural resources) (sec 4(d)(ii), perhaps this could include an ISO 14001 VEMS "voted" for by a regional fishery management council for select fishery management plans seeking an ecosystem-oriented approach to sustainability. Another committee function is the "use of science in establishment of policy on ocean-related matters" (sec 4(d)(iii)) (Presidential Documents, 2004a; see also Presidential Documents, 2004b). The large marine ecosystem (LME) paradigm is a science-based approach to the assessment and management of living resources that considers the human dimension in meeting policy challenges in an adaptive manner (see: e.g. Hennessey and Sutinen, 2005).

"The United States will promote, within the United Nations Environment Program's regional seas programs and by international fisheries bodies, the use of the Large Marine Ecosystem (LME) concept as a tool for enabling ecosystem-based management to provide a collaborative approach to management of resources within ecologically bounded transnational areas. This will be done in an inter-

national context and consistent with customary international law as reflected in the 1982 United Nations Convention on the Law of the Sea." (U.S. Ocean Action Plan, December 17, 2004 see: http://www.whitehouse.gov; CEQ, 2004; see also Belsky, 1985). "Our policies will encourage innovation and employ economic incentives over mandates where possible." And, "the Administration will continue to work towards an ecosystem-based approach in making decisions related to water, land, and resource management…" An immediate and long-term action highlight is to "work with regional fisheries councils to promote greater use of a market-based system for fisheries management." The Ocean Action Plan facilitates the establishment of a "new interagency working group on ocean resources management" whose functions would include identification of "opportunities for improvements in the application of science for ecosystem-based management of ocean resources."

In the United States, the administration is "encouraging market-based incentives to adjust harvest capacity in a fishery can help end the race for fish, improve product quality, enhance safety at sea, and make fishing operations more efficient, ultimately improving the livelihood of those who depend on them" (CEQ 2004). It is also noteworthy that the Coastal Zone Management Act system is a "voluntary" program between the federal government and the states with many incentives for participation offered by the federal government.

Stated objectively "both in concept and practice, the environmental management system approach meshes well with the Administration's management objectives. It provides the platform for meeting federal stewardship goals as well as the management tools to measure and improve performance against these goals" (Connaughton, 2002a p. 4). Connaughton (2004 p. 4) points out by reference "state and local governments in the U.S. also are very interested in environmental management system, with many both incorporating support of the use of an environmental management system by the regulated community, and they themselves implementing an environmental management system" (see for Northeast U.S. examples: Swift, 2002 and Connecticut, 1999).

In Massachusetts under Executive Order 438 of July 23rd 2002 "state sustainability program" the State Sustainability Coordinating Council "shall collect, maintain, evaluate and disseminate best environmental practices being undertaken by individual state agencies to promote sustainable environmental practices and procedures throughout all state agencies" (Swift 2002). For agencies with "multiple environmental impacts an environmental management system will be the most appropriate method of establishing agency-wide procedures to meet the goals of this order." This program cross referenced federal departmental environmental management system policies (letters, memorandums) including ISO 14000 protocols (see: http://www.mass.gov/envir/sustainable/default.htm). Therefore, with the state's Director of Marine Fisheries, a voting member of the New England Fishery Management Council, a selection of these "agency" sustainable environmental practices can be introduced into "federally consistent" fisheries policies as required in the voluntary programmatic application of the Coastal Zone Management Act 1972 as amended, which Massachusetts is a long-time participant. For an opposing view to New England Fishery Management Council policy, see Sanchirico and Hanna, (2004).

As a bureau within the executive branch, specifically the "White House", the Council of Environmental Quality (CEQ) through its chairman notes "the Bush Administration is actively promoting and supporting the implementation of environmental management system(s) … CEQ has expertise on the ISO 14000 series as well as understanding the international standardization process. The CEQ sees the relationship between the purpose of the tools, and the needs and goals of the government in relation to environmental issues. The CEQ has the opportunity to bring to light the connections between performance goals and necessary management tools, and illustrate the value of the standards to help meet the goals" (Connaughton, 2002a p. 5).

Blodgett (2000) writes that alternatives to U.S. command and control approaches to environmental protection has heightened in recent years. One new approach to environmental protection that fosters sustainability are value-based principles drawn from, inter alia, voluntary environmental management systems (VEMS). These may be categorized with "good management practices," the precautionary principle (approach) and ecosystem management (Blodgett, 2000 p. 5). "The management process approach proposes to affect decisions by promoting and reinforcing environmentally oriented values" and that good management practices "are often seen as voluntary alternatives to regulatory mandates." (Blodgett, 2000 p. 5).

Voluntary environmental management system (VEMS) standards such as the ISO 14000 series may provide a mechanism for regulatory process and application transparency in the United States where emerging marine affairs oriented fisheries issues such as approval of transgenic fish for aquaculture production (see Logar and Pollock, 2005) run into drawbacks related to disclosure prohibitions contained in the Trade Secrets Act(s) of 2004. In July of 1992, the U.S. Food and Drug Administration (FDA) jointly with the National Marine Fisheries Service (NMFS) designed a voluntary, fee-for-service seafood inspection program that was based on hazard analysis critical control points (HACCP) concepts – thus voluntary programs are not new to the fisheries industry (Billy, 1994; Brown and Sylvia, 1994). Another voluntary public/private approach, this time related to Atlantic Salmon conservation, involved Champion International Corporation, Georgia-Pacific and another firm initiating the Salmon Habitat and River Enhancement Project in "downeast" Maine (Heissenbuttel, 1996).

Begley (1996b p. 54) reports that outside the United States "regulatory systems are less stringent, less prescriptive, and less adversarial making ISO 14000 a more meaningful tool for organizations to use to demonstrate commitment to good performance." Begley (1996b p. 54) high-

lights that the "abundant record keeping required by ISO 14001 provides regulators with a paper trail of an organization's efforts to prevent and correct problems." "ISO 14000 establishes internationally recognized standards that will diminish barriers to trade and make it easier to do business across borders" (Begley, 1996b p. 51). "Since the ISO 14000 family of standards is recognized internationally, benefits in competitive positioning arising from certification may be realized in foreign as well as domestic markets." Some studies corroborate these findings (see: Berthelot et al., 2003 p. 50).

APPLICATIONS OF THE INTERNATIONAL VEMS STANDARD: ISO 14001

According to the United States National Academy of Science – National Research Council (NRC; 1999) the international VEMS standard, ISO 14000, does not establish specific environmental performance requirements beyond commitment to continual improvement as well as compliance with applicable legislation and regulations. Highlighted aspects of changing the environmental protection paradigm can be seen "from one focused solely on complying with federal regulations to one for which compliance is achieved as part of a more proactive performance-based system" (NRC, 1999 p. 3). The NRC (1999 p. 4) highlighted that the characteristics of VEMS's and ISO 14001 "to be flexible, baseline approach that can be adapted to organizations of all sizes and types, and to a variety of cultures, processes and businesses." For the U.S., a panel of experts of the National Academy of Sciences/NRC could be convened to research and articulate marine fisheries-oriented VEMS (see: NRC, 1999; National Academy of Public Administration, 2001).

"The International Organization of Standardization (ISO) has also dealt with environmental management but on a broader and more global scale. To reiterate the International Organization for Standardization, commonly referred to as ISO, is an international, non-governmental federation of "standards bodies" from one hundred and twenty participating nations. The ISO addresses environmental management on a broader and more global scale through its voluntary environmental management system (VEMS) standard, ISO 14001 and the ISO 14000 series in general. The standards represent unprecedented market-place and scientifically-based consensus initiatives (von Zharen 1998 p. 83). The ISO 14000 series provides specific requirements and principles for environmental management with the goal of internalizing environmental standards into either public and/or private sector actions locally, regionally or globally. "The focus of ISO 14001 is on a management ecosystem" (von Zharen 1998 p. 83). Present applications of a voluntary environmental management system (VEMS) strategy may be found in a plethora of businesses, including segments of the maritime industry. "The ISO 14001 standard is by design generic and thus could apply to all components of maritime activities, including fisheries management and management of marine ecosystems" (von Zharen, 1999 p. 18). The ISO 14001 requires a multifaceted, interdisciplinary look at all aspects of a business or organization's activities, products, or services at all levels in all areas and an analysis of how these interact potentially in an unsustainable detrimental manner with the physical environment. In other words, ISO 14001 focuses on both parts and the whole.

"The impetus for the ISO 14000 series can be traced to the global environmental initiative, the Earth Summit in 1992" (von Zharen, 1999 p. 11). The June 1992 Earth Summit Conference in Rio De Janeiro had as one focus worldwide corporate environmental management (see e.g. Shrivastava, 1995 p. 937). A number of voluntary environmental management systems (VEMSs) were at that time in various stages of development. Major ones included the British Standard, BS 7750, and the European Eco-Management and Audit Scheme, EMAS (Oluoch-Wauna, 2001). Individual industries had developed their own specialized VEMS especially the chemical manufacturers. What was needed, however, was a unified and all encompassing generic VEMS that could embody all industry, organizations (including government and non-governmental entities), and businesses, large, medium, and small that could also pertain to the marine environment (see e.g. Bodal, 2003; Sinclair and Valdimarsson, 2003). Out of this concern in part, emerged the ISO 14000 international voluntary environmental management system series. The ISO 14000 series provides specific requirements and principles for environmental management. The standards are "systems" standards, neither domestic nor intentional legal standards (von Zharen 1999 p. 12). They are intended to harmonize standards across industry organizations primarily in a voluntary manner. The public or private organization (entity) identifies what environmental impacts are acceptable within the prevailing legal regulatory framework, both international (treaties, memorandums of understanding (MOU)) and domestic (in the U.S. "Public Law" and executive orders). The ISO 14000 series may apply to all types of organizations and is structured to accommodate diverse geographical, cultural, and social conditions. Unlike traditional command and control piecemeal regulatory approaches to environmental protection, the ISO 14000 series may simultaneously address all affected media and resources, including living marine species (von Zharen 1999 p. 12).

Moreover, the standards may be grouped as either highlighting evaluation of an organization's management system and activities or focusing on assessment of its products (for example, seafood processing) and/or services (wild capture fishing, aquaculture, "deep-sea recreational, for-

hire fishing trips," etc). It is a "management" standard, not a command and control legal standard. Other types of documents in the series include tools and guidelines (Figure 2). The ISO 14000 series defines management processes to be followed to minimize the impact an organization (entity) will have on the environment. It is up to the organization to identify what environmental impacts are acceptable within the established regulatory legal framework to which it falls. "Effective (voluntary) environmental management system's are based on a realistic view of how organization's work. This includes understanding that it is the people with their handle on the controls who determine whether or not an organization complies with legal requirements" (Giles, 2004 p. 35). The ISO 14001 may be used to augment and proactively precede the traditional piece-meal regulatory approach to stewarding ocean resources (von Zharen, 1998; see also von Zharen, 1995). There are several core principles of an ISO 14001 VEMS (see Figure 14). As a part of these core principles, there is included a framework for setting and reviewing environmental objectives and targets that are communicated to all employees (crew) and that remains available in a transparent diaphanous way to stakeholders[6,7], (however they identify themselves; see: for example, Mitchell et al., 1997).

An effective ISO 14001 voluntary environmental management system (VEMS) can be built on stewardship framework principles such as those of the science-based large marine ecosystem (LME) approach (see e.g. Sherman and Duda, 1999a&b; Duda and Sherman, 2005; Sherman, 2005; Alexander, 1993; Morgan, 1994; Morgan, 1987). The ISO 14000 series incorporates management precepts that are imperative in attaining an ecosystem oriented-approach to sustainability of the marine environment: it provides commitment to environmental performance; a review of environmental impacts; the formulation of objectives and targets; and continual improvement to meeting the environmental policy vision (or mission statement), that is the baseline for prospective (third party) certification (von Zharen 1999 p. 13). The ISO 14000 specialization's encompass a wide variety of aspects including environmental auditing, eco-labeling, self and third party certification, and life-cycle analysis (see Figure 15).

Sproul (1998b p. 141) states the fishing industry is quite suited to implement various aspects of an international voluntary environmental management system (VEMS); whether at the vessel, firm or fishery-wide level. Indeed the Australian government has fostered pilot projects related to fisheries voluntary environmental management systems (see: Australian Government, 2005 and 2004a&b). Typically, the ISO 14000 approach focuses on an individual firm, organization, or entity developing an appropriate VEMS with prospective guidance from "registered" environmental management systems host country base auditors if the entity chooses. The VEMS could be specific to a firm/industry/fishery and follow appropriate established generic ISO guidelines (see: Figure 2; Table 2) that would provide the baseline for its environmental policy development and implementation. Prior to ISO certification (which is not obligatory) however, the system and its implementation procedures could undergo an environmental audit by an independent third party for transparent certification. Periodic internal performance evaluations could occur as a part of environmental audits which could be communicated to interested stakeholders including regulators (see Figures 2, 16). Independence between monitoring and enforcement reviews ensures on-going regulatory and prospective certification compliance while encouraging adaptive management (see Figure 17) improvement practices (see e.g., NRC, 2004a&b) regarding the VEMS and the firm's actual fishery impact on the ecosystem (Sproul, 1998b p. 143).

Certification of a country's products at the macro level or of an organization's produce at the micro level (see Stehr Group 2005) via locally provided human resource teams of independent VEMS-auditors could be articulated in a consistent way to both domestic and international clientele by way of an international "eco-label" protocol that is provided by adherence to ISO 14020 (see also: Gudmundsson and Wessels, 2000; LeBlanc, 2003; Wessels, 2002). (This is analogous to the dolphin-safe tuna moniker in the U.S. consumer market that is regulated by the National Marine Fisheries Service, see also: NOAA, 2000 and 2002; NMFS-Office of Protected Resources, 2005a, b, c, d). Thus, cross-boundary standardization of the eco-label procedure is imperative to not only optimize defensible VEMS documentation, but to avoid non-tariff trade barriers that could materialize in the discord associated with a myriad of potential certification schemes (Sproul, 1998b p. 143; see also Teisl et al., 2002; Joseph, 1994). The ISO "eco-label" protocol simply confirms that the product is what it says it is by analogy, "dolphin safe" (see Sutton 1998 p. 132). Also certified is the documentation practice describing the process by which the product came about. If the process were specifically applied to fisheries, and FAO Code of Conduct for Responsible Fisheries criteria[8] were employed, the auditor process could certify and label fisheries as sustainable and an institutionally ecological practice (Sproul, 1998b p. 143).

Sustainable fishery certification will likely incorporate into every day consumer choice (Allison, 2001). The process of learning how to minimize marine environmental ecosystem impacts while financing socially constructive organization is of paramount importance. Through market forces rather than subsidization, a fundamental shift in thinking may take place. The economy will begin to incorporate ways for people to respond in the market place to the realization that constructive and sustainable processes are at least as important as their end-product. Linking the fishery product with its process (e.g. gear effects minimization on habitat, minimal incidental/regulatory bycatch and discards as well as highgrading, and an end to unresponsible overfishing) is key, the ISO 14000 series VEMS accomplishes this task (Gable, 2003; Sproul, 1998b).

The time is upon the fishing industry as a whole and its milieu of consumer oriented-stakeholders, resource managers, academics, and policy makers, to formulate a legacy for

marine ecosystem sustainable development. Within their grasp is the opportunity to initiate and institutionalize free-market, democratic instruments of choice, such as the ISO 14001 VEMS provides (Sproul, 1998b p. 145) and as part of a large marine ecosystem (LME) socio-economic portfolio approach (Edwards et al., 2005; Edwards, 2005). Current and future generations could utilize and build upon it to foster large marine ecosystem (LME) resource responsibility and guardianship. With determination, an ISO 14001 VEMS program could also integrate mechanisms furthering international and domestic human development and healthy sustainable ecosystems.

The ISO 14000 family of international standards on environmental management supports the internationally agreed to objective of "sustainable development" (e.g. Kates et al., 2005) with a wide-ranging portfolio of standardized methods that provides organizations with best available scientifically valid data (see NRC, 2004a) on the environmental effects of economic activity. This is a precursor to the technical basis for environmental (fishery) regulations. The ISO 14000 series, first printed in September 1996, meets the needs and concerns of those interested in the environmental management of all types of organizations. Specifically the ISO 14000 family of standards comprises a systematic approach of documents related to voluntary environmental management systems (VEMS; i.e., ISO 14001 and ISO 14004) and procedures and documents related to environmental management tools, such as environmental management system audits and environmental performance evaluations.

The goal of VEMS adoption is to help all types of organizations (entities) ensure that their operations comply with environmental laws and that major environmental risks, liabilities, and impacts are properly identified, minimized, and managed (Darnall, et al., 2000 p. 1). They are also meant to be transparent to stakeholders and the interested public. Since the Johannesburg World Summit on Sustainable Development (WSSD; ending in September 2002) incorporated the concept of ecosystem-based management system for a sustainable future the ecosystem effects of fishing needs better scientific scrutiny (Barange, 2003). Dernbach and Feldman (2003 p. 88) state that with regard to the Johannesburg Summit in September 2002, "the concept of sustainable development changed by incorporating environmental protection, and even restoration into the definition of development." (see also Kates, et al., 2005).

Barange (2003 p. 194) claims that the scientific community needs "to quantify anthropogenically driven changes and their consequences in terms of ecosystem functioning, turnover rates, matter fluxes and so on, and to determine whether they are reversible, and if so over what time scales." We need to establish data bases of estimated species abundance and resource management approaches … such an inventory does not yet exist (Barange, 2003 p. 195). It is suggested here that an industry based "voluntary" ISO 14000 series environmental management system could provide a part of that needed data base (see also Zeller et al., 2005). Darnall et. al., (2000 pp. 1 & 2) writes that a VEMS supplies the structural framework to minimize an organizations environmental footprint (see Figure 4). Once an organization implements its VEMS, theoretically, it will not only be in conformance with all (governmental) environmental regulations, but it may also surpass the regulatory standards for many environmentally regulated activities. In addition, the collected fishery biomass data could be studied in aggregate by the scientific community to ascertain ecosystem functioning. Further, the entity may identify opportunities for reducing non-regulated environmental impacts of its activities too. Organizations that adopt VEMS's and are able to reduce their environmental impacts beyond regulatory standards may also lessen their required environmental reporting burdens and their associated costs (Darnall et al., 2000 p. 2).

In the marine fisheries realm, concerning the ecosystem effects of fishing, between 18 and 39.5 million metric tons of mostly dead fish are discarded annually by commercial fisheries which may severely handicap the energy flow in large marine ecosystems (Barange, 2003 p. 194; see Figure 18). "From an ecological perspective, the ecosystem approach recognizes, and aims to remedy the unwanted impacts of fishing on non-target species, habitats and ecological interactions" (Jennings, 2004 p. 280). Shrivastava (1995 p. 937) suggests "because much economic activity occurs within corporations (firms), government efforts need to be supplemented with new voluntary efforts [emphasis added] by corporations (firms) in order to address the industrial induced ecological problems." "Corporations (firms) are the intermediaries that convert natural resources into usable products (commodities; see Figure 7). Natural resource-based industries (fisheries) can play a very constructive role in preserving ecosystems through conservation and resource-renewal strategies." (Shrivastava, 1995 p. 940). This is analogous to humans as an integral part of the ecosystem – not separate from it (Sherman, 2005).

The ISO 14001 context as described by Darnall (2001, p. 2) identifies ISO 14001-certified VEMSs as standards for environmental management. While many organizations or companies for years have utilized VEMSs, ISO 14001 is the first successful attempt to create an international VEMS standard that is certified by an external auditor. And, it can be utilized for either or both domestic or international purposes – important aspects for large marine ecosystem (LME) fisheries management.

Pojasek (2002 p. 83) affirms that the "ISO 14000 environmental management standard is currently the most widely used VEMS around the world." Stapleton, et al. (2001 p. 1), also makes the claim that the "ISO 14001 published in November 1996, is the most widely accepted international standard for VEMS." Thornton (2000 p. 89) articulates the story that by "late 1999, it was announced that suppliers to the automobile industry (in the U.S.) would be required to certify the implementation of (voluntary) environmental management systems (VEMS's) in their operations by the end of 2002. The VEMS's must be in conformance with ISO

14001." Thus, a VEMS standard is born. "Automakers can have a very significant and direct effect on their suppliers' behavior with regard to quality, safety, and environmental performance." (Thornton, 2000 p. 92).

Thornton (2000 p. 93) goes on to theorize that … ISO 14001 certification "assures all parties that the company is working diligently to improve environmental performance, and is willing to go on record with their objective and results." As a part of the precautionary approach (e.g. Dorman, 2005) "ISO 14001 certification can be particularly important in developing countries, where many sensitive environmental issues may arise" (Thornton, 2000 p. 93). Thornton (2000 p. 93) assures that it is the "customer's reaction that will determine the success of ISO 14001 certification" (the Registrar Accreditation Board accredits ISO 14001 registrars in the United States).

Despite its apparent focus on traditional business operations, ISO 14001 also has gained the attention of public policy makers because of its potential and apparent relevance to environmental protection and sustainability (Darnall, 2001 p. 3). Beginning in the late 1990s, state and federal environmental regulators have investigated the use of VEMSs and their role in public policy (see for example, Swift, 2002; State of Connecticut, 1999). One outgrowth of this interest was the formation of the Multistate Working Group on Environmental Management Systems (MSWG) while in concert with the U.S. Environmental Protection Agency (EPA) initiated ten state-level pilot programs to encourage and facilitate VEMS adoption in approximately 60 U.S. based facilities (Darnall, 2001, p. 3). The MSWG and EPA initiated the pilot program to determine the potential VEMSs have for future regulation in any industry. According to Darnall (2001 p. 3) approximately three-quarters of the pilot project facilities were also seeking ISO 14001 (third party) certification (see also NRC, 1999).

Because of the pilot programs, regulators interest in VEMSs has gained momentum and beginning in 2000, U.S. EPA created "Performance Track" to recognize organizations that consistently meet their obligatory regulatory legal requirements and implement high-quality voluntary environmental management systems based on the ISO 14001 framework (Darnall, 2001 p. 3). Regulators interest in VEMSs is rooted in the belief that organizations which adopt VEMSs may meet or exceed their regulatory commitments (e.g. Hart, 1995), thus making the environmental regulatory system less burdensome and restrictive to their operations. Darnall (2001 p. 3) postulates that while scientific evidence on this issue is not yet tenable, if VEMSs demonstrate increases in environmental performance then important governmental-orientated questions arise about whether U.S. executive branch agencies should use ISO 14001 as a tool for them to achieve goals of greater environmental protection. (see, for example Hart, 1995 p. 1000).

The ISO 14001 VEMS family places its focus on the "organization," not the "facility" (Ritzert, 2000 p. 70). "It is not a site management system defined by physical boundaries, but rather a management system for the activities, products, and services of the organization – including people, resources, physical plant or platform, materials, and all the other things that make up the firm, enterprise, or institution" (Ritzert, 2000 p. 70; see Figure 19; Table 3).

The ISO 14000 environmental standards specify the structure of information technology, in the form of a VEMS, that an organization must have in place if it seeks to obtain certification of the VEMS according to ISO guidelines. The ISO 14000 standards describe the basic elements of an effective VEMS (Montabon et al., 2000, p. 5; see Figures 14, 15). For the proactive organization the assumption is that better environmental management will indirectly lead to better environmental performance (Montabon et al., 2000, p. 5).

Montabon et al., (2000 p. 6) divided the "intent" of the ISO 14000 into two general categories. For organizational evaluation, the VEMS, auditing, and performance evaluation standards will be used. The VEMS standards provide the framework for the management system. Third-party auditing and performance evaluations are seen as management tools in the successful implementation of a VEMS. For product/services and process evaluation, labeling, life cycle assessment, and environmental attributes in, for example, seafood/fishery aquacultural product standards would be emphasized.

Thus, in review, according to information available from the U.S. EPA (see: http://www.epa.gov/cgi_bin/epaprintonly.cgi ; online available March 19, 2005) an environmental management system is a framework that helps an organization achieve its environmental goals through consistent re-analysis of its operations (so-called "double loop analysis"). The assumption is that this increased analysis will over time improve the environmental performance of the organization and strive for a healthy sustainable ecosystem. The voluntary environmental management system itself does not require a level of environmental performance that must be achieved; each organization's VEMS is tailored to the organization's industry services, regulations and goals. A VEMS encourages an organization to continuously improve its environmental performance in a synoptic manner, by following a repeating cycle (see Figures 2, 3, 4, and especially 6).

According to Oluoch-Wauna (2001, p. 247) "a successful implementation of an environmental management system and audit also allows an organization to minimize its environmental liabilities and risks." Further, proof of good environmental management could lead to easy attainment of environmental incident insurance coverage at low premiums due to reduced risks. Presently, the utilization of a VEMS and certification or audit as an instrument of environmental protection is in an adaptive management experimental phase. There is as yet no systematic approach to its use, or criteria for analyzing its effectiveness (Oluoch-Wauna, 2001, p. 248). "In due course, environmental auditing will become the norm, part of best environmental practice of firms" (Goodall, 1995, p. 34). To facilitate global acceptance and implementation of sustainable fisheries (and

aquaculture) LME-oriented principles can be framed within a broad arena of voluntary environmental management systems (VEMS) standards that are akin to indicators contained in the socio-economic module.

Therefore, establishment and implementation of an organization's VEMS is central in ascertaining its environmental policy, objectives, and targets, providing a benchmark frame of reference for continuous adjustment and improvement of marine-related environmental performance (Gable, 2003). Tools for environmental management exist to assist the organization in fostering and promoting its environmental policy, objectives, and targets; see Table 2. The ISO 14000 compliance standards are practical tools for the manager (boat captain, fishery permit holder, regulator, etc.) who isn't satisfied with compliance to legislation and command and control directives, they're for the proactive entity providing a strategic approach to conducting, implementing, and evaluating environment-related measures that can bring a sustainable return on investment (Gable, 2003, p. 439). More information on ISO 14000 VEMS usage in the private sector can be found in Coglianese and Nash (2002, 2001). Thus, adoption of ISO 14000 compliance standards could be contained and subsumed into a sustainable "precautionary approach" paradigm. One example is the market-oriented voluntary bycatch reduction program that has effectively reduced bycatch rates in Northeast Pacific trawl fisheries; it is known as the Sea State Program (see: www.groundfishforum.org; see Appendix 1).

ISO RELEASES ISO 14001 AND ISO 14004 REVISION 2004

The ISO 14001:2004 & ISO14004:2004 revisions were released for publication on November 15, 2004 providing an improvement from the original September 1996 version, with more ease of understanding, clearer requirement intent, an emphasis on overall regulatory compliance, and generalized compatibility with its older updated sibling ISO 9000:2000.

The ISO 14001:2004 revision changes includes clarification of terminology, better alignment with ISO 9000:2000, and more emphasis on certain requirements together with the folding in of additional conditions (e.g. Dodds, 2003). Realignment with ISO 9000:2000 allows entities that are interested in combining a voluntary environmental management system (VEMS) and quality management system (QMS), an ease of transition to the revision. This perhaps is now better suited for a seafood processor organization as well as for offshore aquaculture development (Logar and Pollack, 2005; Dalton, 2005; Naughten, 2005; Schmid, 2005; Hoagland et al., 2003). The combining of the management systems can be a natural progression for establishments with joint organization resources.

The ISO 14001:2004 revision includes clarifications that range from simple terminology adjustments, to a complete rewrite of paragraphs, as well as the addition of new requirements. The clarifications and terminology changes theoretically will enhance the understanding of the requirements for the organization. Overall, the updates will likely add clarity to the voluntary environmental management system requirements in the first "new and improved" version since its inception in September 1996 (see Table 4).

CONCLUDING COMMENTS

The precautionary-oriented ISO 14001 VEMS standard can be the catalyst for fusing disparate goals into a global vision of marine environmental sustainability – which is the focus of a large marine ecosystem (LME) approach to living marine resources (see e.g. Sherman and Duda, 1999a&b; Duda and Sherman, 2002). Ammenberg and Hjelm (2002 p. 188) in their study uncovered that many small or micro enterprises are in need of systematic environmental efforts as some entities did not take into consideration environmental issues at all. This is likely the situation for many marine fisheries related efforts as well. Dietz et al., (2003 p. 1909) suggests that in the struggle to govern the commons requirements for complex systems (e.g. Green et al., 2005) adaptive governance may encompass voluntary approaches. These measures and "those based on information disclosure have only begun to receive careful scientific attention as supplements to other tools." They suggest that to gain success it "appears to depend on the existence of incentives that benefit leaders in volunteering over laggards and on the simultaneous use of other strategies, particularly ones that create incentives for compliance." This maybe the situation notwithstanding sanctioning difficulties posing problems under international agreements (Dietz et. al., 2003 p. 1909). They have also found that relying on "one-level centralized command and control strategies" to effectuate efficiencies for governing world resources have also failed (Dietz et. al., 2003 p. 1910; e.g. Table 5). Kollman and Prakash (2002 p. 60) highlight that local or "domestic factors such as organizational arrangements, regulatory styles, and market structures significantly influence firms' incentives structures" to taking up "beyond compliance" VEMS codes such as ISO 14001. "Although showing some promise, rights-based management has yet to demonstrate its ability to cope with ecosystem-based management" (Sinclair et al., 2002 p. 262; see also Figure 20). Individual fishery quota's or dedicated access privileges "may reduce overcapitalization and inefficiency in U.S. fisheries, they do not lead to ecosystem protection

and sustainable fisheries" (Rieser, 1997 p. 817). "Ecosystem management is further hindered by the fact that a (U.S.) regional fishery management council cannot manage fish populations throughout their range because authority over the entire marine ecosystem is fragmented between different entities" (Hanna, 1997 p. 228; see also Figure 21).

Hence, adoption of consensus based voluntary environmental management systems (VEMS) can help facilitate an incremental movement toward ecosystem-oriented fisheries science policy. Steger (2000 p. 32) suggests that an "ecological limits-driven" VEMS can contribute to sustainable harvests in the long term for specific ecosystems. Valdimarsson and Metzner (2005 p. 288) advise that a fisheries oriented firm-based response to perceived consumer market pressures ought to include compliance and environmental standards such as ISO 14001. The ISO 14000 series aims at the establishment of ecological considerations in the decision-making process on the granting of permits (or "dedicated access privileges"). Fisheries oriented firms must increasingly secure a permit (license) to operate directly from civil society, in conjunction with regulators, by illustrating their commitment to sound environmental policy and performance (e.g. Neumayer and Perkins, 2004 p. 830). The ISO 14000 series framework can demonstrate such a commitment. Neumayer and Perkins (2004 p. 836) imply that ISO 14001 could be a complement to public law and regulation. Imperial and Yandle (2005 p. 499) caution "setting a TAC can be problematic when decision makers are confronted with scientific uncertainty. The process can also be distorted if fishers increase catch in an effort to 'fish for quota' in the years leading up to the introduction of an ITQ system" (re: dedicated access privileges).

This review has attempted to address the hypothesis by Hanna (2002 p. 4) that the "existence of property rights (in fisheries) would allow the focus to shift toward performance-based regulation, where the right to fish depends on certification of meeting specified conditions." Taken literally, this paper, through a normative review and synthesis of the best available science literature, finds that "certification" to ISO 14001 VEMS conditions is able to foster performance towards sustainable ecosystem-approaches to fisheries. The ISO 14000 voluntary approach provides entities the flexibility to develop VEMS that are appropriate to their business characteristics, levels of risk, location and operations (Rondinelli and Vastag, 2000 p. 501). "While ISO 14001 does not eliminate the need for government regulation of industry, it should help industries improve their ability to meet the expectations of regulators" (Raines, 2002 p. 425), this may be especially true for emerging "sector organizations" in commercial fisheries operations (see e.g. GAO, 2004). Further, it is also possible that insurance companies, and perhaps the banking industry, maybe more willing to accept certification to ISO 14001 VEMS as evidence of reduced environmental risk-taking by entities (e.g. Raines, 2002 p. 421) and thus offer special rates (Kollman and Prakash, 2002 p. 48). With regards to environmental management system implementation, Fryxell et al., (2004 p. 243) hypothesize that the "effectiveness of major environmental management system components will be influenced by motivations for certification." Their hypothesis was generally supported – "the strongest motivations were to ensure regulatory compliance, enhance the organization's reputation and improve environmental performance, respectively" (Fryxell, et. al., 2004 p. 247). Lastly, Delmas (2002 p. 99) proffers that the "government can also promote the adoption of ISO 14001 VEMS by threatening to issue a mandatory environmental management standard (that may be more stringent than ISO 14001) if firms are not voluntarily adopting ISO 14001 in its present form."

As stated in the introduction, Gober[9] (2000 p. 8) points out "modern synthesis is organized around ideas, concepts and theories. It emphasizes discovering strategic connections…," it may involve linking already discovered ideas in innovative ways, in grappling with large and complicated human and natural systems, and in looking for analogies in seemingly unconnected fields." Thus, it is proposed here that the application of voluntary environmental management systems (VEMS) can serve as an integrated useful tool that can strengthen and improve large marine ecosystem environmental quality and sustainability.

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ENDNOTES

1. Moreover, in a memorandum letter dated November 19, 2003, concerning the "establishment of environmental management systems," the then Assistant Attorney General for Administration of the U.S. Department of Justice recommended that each Federal Bureau establish a voluntary environmental management system that reflects ISO 14001 or similar standards. He also wrote that agencies ought to consider "procedures and processes necessary to enable organizations to perform their functions consistent with regulatory requirements, environmental policies, and agency mission."

2. The Commanding Lieutenant General of the U.S. Army Corps of Engineers, in a memorandum dated May 19, 2003 (Commander's Policy Memorandum #11), stated that the "environmental management system represents a framework through which an organization identifies attainable indicators of environmental performance, continuously seeks to improve its environmental performance in measurable ways, and documents these improvements." Further he went on to write, referring to Executive Order 13148, "while these voluntary environmental management system requirements are oriented to federal facilities, they do not preclude the eventual development of programmatic environmental management systems." Further, the Department of Army has directed, the Corps of Engineers environment management systems will be based on the International Organization of Standardization framework ISO 14001. The U.S. Department of Agriculture Secretary in a memorandum dated July 29, 2004 (memo #5600-001), regarding USDA Environmental Management System Policy, enacted a doctrine that "environmental management will be an integral part of day-to-day decision-making and long-term planning across all USDA mission areas and in all USDA missions, activities, and functions." The then Secretary of Commerce, Donald Evans, by and large echoed these same intentions in a memo dated April 22, 2003.

3. Wixted (2003) provided an implementation guide for U.S. Department of Commerce environmental management systems. The 18 steps in the guide drew upon ISO 14000 standards in describing VEMS elements, stating it is a widely-accepted international standard for a continual-improvement-oriented VEMS.

4. Wixted (2003) reconfirmed the intent of Secretary of Commerce Evans' memorandum issued on April 22, 2003, that the "success of our mission requires a commitment to continual improvement in our environmental management performance. The environmental management system is the tool to assist us in meeting this commitment." The VEMS serves as a tool for improving overall agency and environmental mission performance (Wixted, 2003 p. 3). The ISO 14001 VEMS approach is specifically referred to by the guide.

5. As a bureau in the Department of Commerce, NOAA's mission, inter alia, is to conserve and wisely manage America's coastal and marine resources to ensure sustainable economic opportunities including the goal of ecosystem-based management. The National Marine Fisheries Service of NOAA works in partnership with … (8) regional fishery management councils crafting measures to prevent overfishing, rebuild stocks, and reduce bycatch among other objectives (Department of Commerce Ocean and Coastal Activities Report of the Office of Management Budget (http://ocean.ceq.gov/activities/welcome.html), online available December 18, 2004.)

6. Co-management is featured as the basis on which to build sustainability strategies in which all stakeholders participate. Co-management, synonymous with cooperative management, joint management, and collaborative management, is defined as a system that enables a sharing of decision-making power, responsibility, and risk between governments and stakeholders including, but not limited to, resource users, environmental interests, experts, and wealth generators. It is a form of power sharing, that fisheries stewardship programs can integrate (von Zharen, 1998 pp. 85 & 86).

7. In order to establish its legitimacy, a co-management regime must be created from a mandate, such as a memorandum of understanding (MOU) among participating parties. Other core elements are essential to the success of a co-management VEMS. The first is a strong supporting institution — the council, board, or agency charged with implementation. Another element is effective engagement of stakeholders in order to "probe the intricacies of key issues, to define the values and principles for action, to explore new concepts, to forge alliances, and to create a legitimacy for the implementation and delivery phases" (von Zharen, 1998 p. 88).

8. The Code of Conduct for Responsible Fisheries has specific articles for implementation of sustainable development provisions contained in the Code in, for example, both fishing operations (Art. 8) and fisheries management (Art. 7). According to Garcia (2000 p. 536) "this structure is convenient because it is explicitly addressed to the various types of actors required to implement the Code: the policy and

decision-makers; managers; fishermen; fish processor and traders; fish farmers;" as well as scientists (fisheries research is found in Article 12). "While the FAO Code is a voluntary and non-binding instrument, the United States has consistently supported its usefulness as an internationally agreed upon statement of principles that should govern the policies of FAO members in all sectors of the fishing industry" (see: *Federal Register* 67 (164), August 23, 2002 at page 54645; and *Federal Register* 65 (210), October 30, 2000 at page 64683).

9. Patricia Gober is a former invited NOAA Science Advisory Board member when James Baker was Undersecretary for Oceans and Atmospheres in the Department of Commerce. She mentions in her article that NOAA "recently recast its mission to encompass environmental stewardship. Its goals of building sustainable fisheries, recovering protected species, maintaining healthy coastlines and delivering better forecasts are ripe for social science input" (Gober 2000 p. 5, referencing the "NOAA Strategic Plan: A Vision for 2005", published in 1996).

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APPENDIX 1:
HARNESSING MARKET FORCES IN AMERICAN FISHERIES SCIENCE POLICY (CASE EXAMPLES)

Increased public support alone will not reverse the fisheries crisis (e.g. Table 5) although it remains a vital component of the long-term solution. Market forces are necessary to counter unsustainable fishing and its proponents. One approach is available that has succeeded in other areas, that is, working in partnership with industry to design and implement market-derived incentives for sustainable, well-managed fishing (Sutton, 1998 p. 132).

Perhaps one of the earliest best example of this strategy was the highly successful and rather controversial tuna-dolphin campaign of the early 1990s (see also Joseph, 1994; Jennings, 2004). Hundreds of thousands of dolphins were being killed in purse seine fisheries for tuna in the eastern Pacific. Public outrage and consumer power helped provide the political incentive for the US to embargo imports of tuna caught in an unsustainable manner resulting in excessive mortality of dolphins. Thanks to the successful marketing of dolphin-safe tuna by major seafood distributors, the killing of dolphins in tuna fisheries was quickly reduced, at least for U.S. based consumers. The goal of that campaign, however, was dolphin protection and not fisheries conservation (Sutton, 1998 p. 132).

To succeed in promulgating market forces in fisheries, the conservation community should forge alliances with progressive members of the seafood industry. The Marine Stewardship Council is one such joint venture (see later). The tuna-dolphin experience suggest that finding corporate allies and redirecting market forces in favor of conservation can be quite powerful. "One thing is certain; where public opinion, industry and the market lead, governments will likely follow " (Sutton, 1998 p. 132).

Another example is in U.S. North Pacific fisheries where bycatch of prohibited species such as halibut and crab is stringently regulated (see e.g. Witherell, 2004). Typically every year groundfish and cod fisheries are closed because fisherfolk have caught the regulatory bycatch cap of halibut or crab allotted to a permitted directed species fishery. Hall et al., (2000 p. 204) states "it is clear that bycatch management will be an integral part of most future ecosystem management schemes."

Gear innovations are only a partial solution for reducing bycatch of these species. Gear innovations (i.e. conservation engineering), is an approach that has proven effective is area avoidance. The fishing industry's ability to establish avoidance of areas with higher incidence of crab and halibut (so called bycatch "hot spots") was once quite limited. Traditionally fisherfolk only had access to the U.S. National Marine Fisheries Service (NMFS) observer data collected on their vessel and these data were often only collected and available weeks after the bycatch occurred. The demersal north east Pacific groundfish industry has alleviated that situation with the creation of a voluntary reporting system known as "Sea State." (see e.g. Groundfish Forum, 2005; Gauvin and Rose, 2004; Haflinger, 2004; Gauvin et. al., 1996).

Haflinger (2004 p. 232) reports that under the Sea State program fisheries-related "observer data are available to Sea State Inc. (Seattle, Washington; as the owner's agent) on a 24/7 basis via an automated Web site maintained by the North Pacific Groundfish Observer Program." Hot spots that are noted, where "bycatch" has been high become a program of "voluntary" area closures. This may be akin to a rolling industry-based marine protected area.

To get around the data barrier and improve the industry's ability to avoid bycatch hotspots, in "real time," Groundfish Forum (an industry member based association) has voluntarily contracted with a third-partly contractor known by the name, Sea State. Sea State based in Washington State as an independent contractor, receives NMFS data via satellite from participating vessels. The data are used to generate charts in a geographical information system (GIS) that are transmitted back to vessels. These charts indicate locales or areas where bycatch is high and the information is updated every 24 hours. Sea State works under a data release agreement between the industry and NMFS. Further, Sea State as the contractor provides each participating vessel with a list of vessels and their bycatch rates, which eliminates the excuse that the boat captain didn't realize his bycatch rates were high. Transparent knowledge and dissemination creates strong peer pressure that acts as an incentive to reduce bycatch.

The Sea State Program is analogous to a fishery-based ISO 14001 VEMS, works as follows: First, trained observers sample hauls and estimate catch and bycatch. Second, each vessel electronically transmits its observer data to Sea State that checks the data and performs spatial statistical extrapolations to factor in any hauls that were not sampled. Third, position-specific data plotted from satellite triangulation global positioning systems (GPS) for each vessel is used to create a chart of vessel-specific bycatch rates that is faxed to participating member vessels within 24 hours. Fourth, vessels move away from high bycatch areas and exert peer pressure on any vessel that is reluctant to move.

At times, high directed fishery – target total allowable catch (TAC) fishery – catch-rates must be sacrificed to keep bycatch discard rates low. The industry hopes peer pressure put on those who are not participating in the example voluntary ISO 14000 – oriented Sea State program will influence them to act for the common good of all in the regulatory industry. Accordingly the goal of the Sea State (bottom trawl) program is to allow the fleet to rapidly respond (both individually and collectively) to high bycatch rates. In this way, bycatch and/or discards of prohibited species

can be minimized and the industry can more effectively stay within its overall legislatively prescribed prohibited species regulatory bycatch caps (Gauvin et al. 1996 p. 79).

Unfortunately, throughout the country NMFS does not have sufficient financial and manpower resources for data processing and transmission of bycatch information in a suitable time frame needed for bycatch avoidance (see: Hill, 2002). It cannot afford nor provide enough observers either. Moreover, government rules pertaining to confidentiality allow individual companies to receive only their own fishing data which is neither useful for establishing bycatch trends nor for avoidance. The contract with Sea State works through a general clearance agreement between participating fishing enterprises, NMFS, and Sea State (Gauvin et al. 1996 p. 80). "This allows for the calculation of bycatch rates per ton of target catch while providing protection from general dissemination of individual catch data." For the identification of bycatch hot spots to be effective, there needs to be identifiable patterns based on spatial and temporal dimensions. This science-based condition is not often met.

A crucial determinant of success for any voluntary ISO 14000–oriented VEMS program is to obtain a critical mass of the industry to participate. Further, there must be a legitimate reason why a company would want to participate because "volunteerism normally wanes where there is no tangible reward" (Gauvin et al. 1996 p. 81). Seymour and Ridley (2005 p. 324) link participation to the existence of "market incentives." There is clearly a common benefit to the industry if the program successfully prevents premature closures of fisheries prior to the TAC being taken. It also augments sustainable development "best practices" (Sainsbury et al., 2000; Sainsbury and Sumalia, 2003)

Some members of the North Pacific bottom trawl fleet believe the only real long-term solution will be a management system of individual accountability wherein an individual organization or enterprise directly affects its own economic performance by its efforts and ability to reduce bycatch (Gauvin et al, 1996). Adoption of an ISO 14001 VEMS is just such a tool. This ISO 14000 system might be one where individual vessels have an annual allotment of groundfish bycatch and must stop fishing as soon as that allotment is used up. Under such a system, companies would have incentives to use their bycatch wisely and lower their rates, to the maximum extent practicable, to extend their fishing time and increase production. This would be reflected in a transparent third-party VEMS certification document (see, e.g. Figures 2, 3, 6, 16).

Under a system of individual accountability, an organization doing its utmost to reduce bycatch (a requirement of the Sustainable Fisheries Act of 1996), even at a cost of directed fishery target species catch, would not be affected by a company unwilling to sacrifice target species catch to reduce bycatch. "A system of individual bycatch quotas would not penalize the good actors while allowing bad actors to gain economically" (Gauvin et al. 1996 p. 82).

Gauvin and Rose (2004, p. 218) report that in the U.S. Pacific northwest "the pollock industry employs voluntary bycatch monitoring and avoidance to rapidly identify salmon 'hotspots' and move fishing into lower bycatch areas," notwithstanding opportunity costs of "forfeiture of areas with high pollock catch rates or fish quality."

Corollary Discussion: Industry Initiatives – Voluntary Bycatch Reporting in 2005

The East Coast Pelagic Association (ECPA) of Maine elaborated on some equivalent voluntary ISO 14000-oriented fisheries bycatch reporting. The ECPA and the herring industry are cooperatively working to develop a voluntary bycatch avoidance program analogous to an ISO 14000-oriented VEMS, primarily to address recent interactions with an extremely large in relative terms, 2003 year class of haddock on Georges Bank. Some of this 2003 year class of haddock began to be caught as incidental "bycatch" (discards) in the permitted directed herring fishery in 2004. This led to closure of the fishery (e.g. see also: Gauvin et. al. 1996; Haflinger, 2004). The new voluntary bycatch avoidance program may be operational as early as July 2005 (Steele, 2005).

In 2004, the Atlantic herring midwater trawl fleet encountered as bycatch/discards a phenomenal 2003 year-class of haddock along the western edge of Georges Bank actually the largest since the 1960's (Jon Brodziak, NMFS, personal communication)! Herring midwater trawls are utilized to capture pelagic species successfully in many parts of the world; locally these encounters with haddock groundfish species were an unprecedented event with detrimental repercussions for the commercial fishery. All retention of groundfish species by herring vessels is prohibited under fishery regulations promulgated by the New England Fishery Management Council (Steele, 2005; but see: Federal Register Vol. 70 (112) pp. 34055-34060, June 13, 2005). Compliance with these prohibited species regulations are complicated by herring vessel operations that utilize submergible hydraulic pumps, which limit the vessel crews ability to successfully sort bycatch of species of similar size.

There is a need to avoid waste of both target species (herring) and valuable U.S. Atlantic haddock that will eventually recruit to the groundfish fishery if left in the ocean (see also Cho et al., 2005). The herring industry is pursuing a three-pronged approach to continuing the harvest of a healthy herring resource while minimizing incidental bycatch of haddock. One approach coincides with gear modification research. A second is analogous to a voluntary ISO 14000-oriented VEMS bycatch avoidance program. The third approach involves regulatory change. This "corollary discussion" is intended to describe a pilot industry project analogous to an ISO 14000-oriented approach under development in cooperation with the Gulf of Maine Research Institute (GMRI) of Portland, Maine, the East Coast Pelagic

Association (ECPA) and other members of the herring industry (Steele, 2005). Avoidance programs have proven successful in other regulated US fisheries and this pilot project seeks to utilize "lessons learned" in successful implementation while taking into accord the difference in resources specific to the U.S. Northeast Continental Shelf LME region (e.g. Gauvin et al., 1996; Haflinger, 2004). The objectives include the development of a program that will assist the herring industry in minimizing haddock bycatch to the extent practicable. Another prominent objective is to utilize vessel information voluntarily provided on a tow by tow basis to identify bycatch "hot spots" – during a 24 hour reporting cycle – and compile data on fishing and environmental conditions that may influence bycatch rates, and thus, to avoid those areas.

The 2004 Georges Bank fishing experience had some quite significant economic impacts on herring fisherfolk and shoreside processors. Some vessels were assessed significant fines for violations of possession of prohibited species (haddock) (Steele, 2005). Reduced effort on a healthy resource of herring was seen immediately as vessels voluntarily agreed to leave areas of concern, so called "hot spots." Several processors experienced severe shortages in product and some plants were shuttered for periods during the directed herring season (Steele, 2005).

Regulatory change is needed to address unintended bycatch of haddock in the fishery, but the process is slow and ponderous in a region that has been focused in recent years on management of overfished species of low abundance and on rebuilding plans. The success of these rebuilding efforts now requires the need to develop tools to manage abundant species interactions as a part of an ecosystem approach to fisheries management (Pitcher and Pauly, 1998). This pilot project as described and presented in New England Fishery Management Council documents seeks to explore the utility of a voluntary industry initiative as a part of a co-management ISO 14000-oriented approach to avoid and minimize incidental bycatch and regulatory discards.

According to ECPA personnel, the herring industry feels compelled to take proactive steps to avoid species interactions (as bycatch and discards) while regulatory actions are formulated. The regulations were still uncertain, as of early June, for the 2005 fishing season on Georges Bank. The herring fishery will have an opportunity to operate should the National Marine Fisheries Service (NMFS) implement a 1,000 lb. haddock incidental bycatch limit as requested for 2005 by the New England Fishery Management Council (NEFMC; Steele, 2005), which they did (see Federal Register, Vol. 70 (112) pp. 34055-34060, June 13th, 2005) while the industry continues its co-management efforts on a more permanent bycatch monitoring program for the fishery.

To meet the objectives of the pilot project, vessels who choose to participate in this voluntary effort will need to report data on a "tow by tow" basis, indicating location, bycatch rates, and other determinate factors. ECPA hosted a captain and vessel owner meeting in June of 2005 in an effort to reach agreement on the level of information needed to be shared among the participants to meet the objectives of the program. Discussions also featured confidentiality and use of information reported. As a part of this analogous ISO 14001 VEMS–oriented effort, vessel owners and captains will be asked to sign an agreement (as a memorandum of understanding) to comply with the terms and conditions of the consensus of the participants.

The Gulf of Maine Research Institute in Portland, Maine (GMRI) has agreed to act as a clearinghouse for information reported by vessels, for compilation of data and the subsequent reporting back to vessels on haddock bycatch rates. Position-specific data (e.g. latitude and longitude) for each vessel will be used to create a chart of vessel-specific bycatch rates that will be faxed or emailed to participating vessels on a 48-72 hour cycle, this cycle it is hoped would be reduced to daily (see: Gauvin et. al., 1996).

All vessels in the directed herring fishery are currently using a Boatraks vessel monitoring system (VMS) with email capability that will be utilized to facilitate timely reporting of data (Steele, 2005). The pilot project is currently investigating the use of electronic logbook software to facilitate ease of use for captains while in operation on the sea.

During New England Fishery Management Council herring advisory meetings held in May of 2005, Steele (2005) maintained that under regulations then in effect, vessels must operate with zero retention of haddock. According to ECPA personnel anticipated regulatory change (at least for the 2005 season) will likely allow for some low levels of retention of haddock and vessels will need to utilize consistent methods to estimate bycatch rates on individual trips. It is suggested here that an in-place VEMS by the vessels, with third party certification to ISO 14001 protocols will aid in effectuating transitional regulatory change. As a part of the overall pilot project effort to increase data the NMFS Observer Program will endeavor to provide at-sea observers on 20% of herring trips in 2005 (Steele, 2005). This pilot project proposes to have fisherfolk employ the same protocols and methodology used by the NMFS Observer Program for at-sea observations to allow data collection comparison. Both ought to be standardized to international ISO 14001 VEMS protocols.

Fourteen vessels attempted to work in the marine area of concern in 2004. These vessels are known and definable and have been successful in achieving compliance with industry oriented agreements or memorandums of understanding (MOU) in recent years. While this project does not anticipate a significant change in vessels operating in the fishery in 2005, the open-access and common property nature of the fishery may complicate full compliance if many choose not to participate in this voluntary approach. The NEFMC is preparing an amendment to the Atlantic Herring Fishery Management Plan (FMP) that will analyze a limited access program that may be implemented for the fishery in the near future (Steele, 2005). It is suggested here that those vessels employing an ISO 14000-oriented voluntary environmental management system (VEMS) with third-party

certification will find favor with regulators when prospective limited entry "dedicated access privileges" are granted (see, e.g. Hart, 1995).

Herring vessels were unable to operate prior to the total allowable catch (TAC) being taken in some areas of the fishery in 2004 because of unavoidable haddock bycatch. Limited by regulation, vessel captains where unable to ascertain any correlations in directed herring fishing patterns that could influence overall bycatch rates temporally or spatially. There is a clear need for collection of information to define the extent of the problem in the fishery (Steele, 2005). This pilot project to self report seeks to assess fishing data to determine bycatch rates in "real time" and identify any long term or seasonal trends of interactions with the rebuilding haddock resource (see also Gauvin et al., 1996; Haflinger, 2004).

As mentioned earlier, the herring industry will also be looking at gear modifications in 2005 and beyond to minimize incidental bycatch. That research will utilize available information on fish behavior (haddock/herring) to test modifications for midwater trawls to improve escapement of haddock. A cooperative research project has partnered the Manomet Center for Conservation Sciences in Plymouth, Massachusetts with, GMRI, NMFS and ECPA to seek funding to fully test modifications to midwater trawls to increase escapement of haddock. Perhaps congressionally approved Saltonstall Kennedy funds would be quite appropriate for this endeavor (but see Buck, 2004 for his assessment of funding problems with this 50 year old law).

While the goal of some flume tank gear work is to minimize bycatch, the need for active avoidance of areas of high bycatch by the industry is still required by regulation. The voluntary bycatch reporting pilot project identified in this corollary discussion would allow the industry to experimentally test the effectiveness of a self-regulated process as a part of an adaptive management ISO 14001 VEMS approach, to collect data while minimizing bycatch rates in the directed herring fishery.

In summary, while the data may provide some perspective on the nature and extent of catch and incidental bycatch on vessels using pelagic gear and catching herring, they are not comprehensive enough as yet to draw any specific conclusions about the herring fishery as a whole, nor about any specific individual gear type. Steele (2005) makes the case that it therefore would be inappropriate to conclude that groundfish bycatch is a problem in the herring fishery, just as it would be inappropriate to conclude that groundfish bycatch is nonexistent in the herring fishery. Additional ecosystem-oriented information is required to make such conclusions, though, however, year class 2003 haddock appear to be a "problem" for the directed herring fishery. Sinclair et al., (2002 p. 261) stated "heavy fishing on small pelagics such as herring, capelin, sardines and anchovies has resulted in changes in the distribution and abundance of predatory fish…"

Overall, observer data from the herring fishery are not sufficient to uphold a robust statistical analysis to determine groundfish discard/kept ratio at this time (Steele, 2005). The observer coverage of the herring fishery during the 2004 fishing year was a pilot program, and the adequacy of the temporal and spatial coverage has as yet to be evaluated for regulatory purposes. Although the basic sampling protocol is well-defined, the effects of individual vessel sorting procedures on sampling also require rigorous evaluation (Steele, 2005).

The Maine Department of Marine Resources/Manomet data probably provide the best perspective on the nature of bycatch in the directed herring fishery. These data only represent a snapshot however, of the fishery as they were collected in 1997 and 1998. No similar projects have been undertaken to investigate bycatch in the directed herring fishery since that time. The project conducted by ME DMR that utilized portside bycatch sampling may be a cost-effective way to obtain a significant amount of information to complement the at-sea observer information (e.g. Bache, 2003).

Bache (2003 p. 103) indicates that "largely through the allocation of catch quotas and access rights "ownership privileges to commercial fisherfolk are perceived to accrue." Bache (2003 p. 122) emphasizes that in order to mitigate the bycatch of commercial species different approaches are required, however, "there is no one size fits all solution to bycatch problems." Some available tools include the use of market measures and incentive programs, and the voluntary ISO 14001 VEMS approach may be an appropriate tool or mechanism for integrating ecological information into natural resource management policy (see also: Brown and MacLeod, 1996).

APPENDIX 2:
A SOCIO-ECONOMIC STRATEGY FOR THE OCEAN'S ECOSYSTEM THROUGH VOLUNTARY ENVIRONMENTAL MANAGEMENT SYSTEM(S) (VEMS) IN AN LME FRAMEWORK

While described in other documents at length (see Sherman, 1994, 1995) briefly, the concept of LMEs emerged from an American Association for the Advancement of Science (AAAS) selected symposium in the mid 1980s concerning variability and management of large marine ecosystems (Sherman 1991; Alexander, 1993; Morgan, 1994; Morgan, 1987). Rosenberg (2003 p. 190) states that the "LME concept is helpful for thinking of the linkages of biological, chemical and physical factors of transboundary coastal ocean areas. Affecting any one part of the LME can have repercussions throughout the region. The LME provides a framework for thinking about potential impacts." The impacts on fisheries ecosystems including the biological, oceanographic and physical environment that supports commercial and recreational species within a specified management area and other economic activities such as sand and gravel mining, submarine telecommunications links, oil and gas energy development, marine transportation, contaminants disposal, recreational tourism and aquaculture, can occur at the scale of LMEs or may be localized in scope (Rosenberg 2003). Rosenberg (2003 p. 194) also points out "aquaculture may cause habitat degradation and competitive interactions between farmed and wild fish, which in combination reduce the productivity of the ecosystem and hence fisheries" (see: Dalton, 2005). This large marine ecosystem (LME) approach or concept may involve integrating stewardship of the ocean's ecosystem into a workable and adaptive voluntary environmental management system (VEMS) as a part of the socio-economic and governance modules (see Figure 11). Although a VEMS may take many forms, there are essential ingredients that ought to be included. A viable VEMS ought to consider the viewpoints of identifiable stakeholders and interested parties to maximize the potential for achieving objectives in gaining maximum sustainable yield from "public trust" resources. Therefore, effective stewardship ought to be predicated on several principles (von Zharen 1998 pp. 107-108: see Figure 22).

Hanna, (1999 p. 282) emphasizes "moving to ecosystem management requires an explicit consideration of multiple objectives not only for the production of commodity species but also for the protection of species that provide ecosystem services, it also requires a mechanism to overcome difficulties presented by entrenched single-species interests." It also requires a central organizing principle, (Juda and Burroughs, 1990) ecosystems are such organizing principles (Hanna, 1999 p. 282). "Improving fishery governance will require that tradeoffs between species be considered within a context of ecosystem portfolios (e.g. Edwards et al., 2005; Edwards, 2005; Edwards et al., 2004; Larkin et al., 2003) with the objective to maximize the sum of commodity and service values over the long term" (Hanna, 1999 p. 283; see Figure 23).

"Incentives could be realigned to provide rewards to both users and managers for behavior that promotes sustainable use, for example, by making the continuation of both rights of access (referred to as "dedicated access privileges: CEQ, 2004) and rights of management contingent on positive contributions and innovation" (Hanna, 1999 p. 283). It is proffered that the utilization of an ISO 14001 VEMS is just such an innovation.

It may be noteworthy that the second organization in the United States to receive ISO 14001 certification of its voluntary environmental management system was the Acushnet Rubber Company of New Bedford, Massachusetts. The Massachusetts Toxics Use Reduction Act of 1989 provided the impetus for Acushnet to fulfill ISO 14000 requirements for continuous environmental improvement (Ochsner, 2000). This example is meant to illustrate that organizations in "fishing communities" have already instituted VEMS applications.

"It must be acknowledged that the initial development and implementation of the (voluntary) environmental management system will take time and money" (Pendleton and Nagy, 2003 p. 62). To find prospective funding, Buck (2004 p. 1) indicates that the "objective of the Saltonstall-Kennedy (S-K) Act (established in 1954) program is to address the needs of fishing communities in providing economic benefits for rebuilding and maintaining sustainable fisheries, and in dealing with the impacts of conservation and management measures." Thus, it is reasoned here that a rejuvenated S-K program could provide pilot funding for fisheries industry-based ISO 14001 VEMS development and partnering (but see Buck, 2004).

In the United States, the EPA strategy in determining the role of voluntary environmental management systems (VEMS) in regulatory programs is to ensure that "voluntary programs will remain the primary way in which the agency promotes and encourages the use of environmental management system's," in part, to improve regulatory compliance and obtain continuously improved environmental results (Johnson, 2004 p. 2). The EPA feels that when regulators focus on performance, certain implementation considerations are warranted. They believe "(voluntary) environmental management systems generally should not be used to replace performance standards defined by regulatory programs (one example may include the 10 National Standards found in the Sustainable Fisheries Act of 1996), but can be useful tools for organizations to use to achieve such standards" (Johnson, 2004 p. 4). The EPA also proffers that nonregulatory VEMS elements are conditions for receiving

regulatory benefits (perhaps in the case of fisheries – "dedicated access privileges"). Voluntary environmental management systems (VEMS) are a multimedia approach whereby an organization can effectively take into account unregulated environmental impacts and regulatory requirements in unison. A VEMS can also be utilized as an adaptive management policy experiment.

It is quite possible that incorporating a VEMS into a permit could yield better environmental results and public (stakeholder) involvement than traditional permit models. For exclusive economic zone (EEZ) public trust fishery resources, involving the public through VEMS's may meet the letter and spirit or intent of required statutory and regulatory permit provisions and may forestall a bevy of lawsuits. It could also be designed so that confidentiality remains respected and balanced for the permit holder. It is also prospectively possible that VEMS's could facilitate the generation and tracking of permitted fisheries "dedicated access privileges" and the subsequent trading programs that result from implementation of individual transferable quotas (ITQ's). The "dedicated access privileges" of trading permits and catch within the framework of a VEMS could aid regulators in determining the net environmental and ecosystem-oriented health impacts from trading programs as a result of such "dedicated access privileges." The gear makers (hook, net and so forth) could be persuaded as "third parties" suppliers to actively engage in voluntary environmental management system development and continuous environmental performance (sort of like the automotive industry suppliers). Linking permits or "dedicated access privileges" to high quality VEMS's and certification could become an important element in the human dimension (see Figures 24, 25) to continuous environmental improvement of sustainable large marine ecosystems (see: Stehr Group, 2005). If the adaptive management VEMS experiment does not achieve stated goals or is terminated (as a policy orientation approach; see: Gable, 2003, Table 6) by either a participant permittee or a regulator, or by legislation, any deferred requirements may need to be reinstated under a new permit. In linking permits or "dedicated access privileges" and VEMS's the monitoring and verification for compliance with key permit terms and conditions can be accomplished at the dock during unloading of catch, through contracted fishery observers, or perhaps through electronic vessel monitoring systems (VMS). All of which are used in one form or another today. The fishery resource implications to regulators of substituting VEMS terms and conditions for permit provisions are such that market-based initiatives, which are supported by the present U.S. Administration, will foster humans as integral parts with large marine ecosystem resources and their subsequent sustainable use (see: Sherman, 2005).

APPENDIX 3:
THE MARINE STEWARDSHIP COUNCIL AS ANOTHER EXAMPLE OF NON-GOVERNMENTAL AQUATIC VOLUNTARY ENVIRONMENTAL MANAGEMENT SYSTEMS

Two global organizations announced in February 1996 a "partnership" to create economic incentives for sustainable fishing by establishing an independent non-profit Marine Stewardship Council (MSC). The world's largest private, non-profit conservation group, the World Wide Fund for Nature (WWF) sought a new approach to help ensure more effective management of marine fisheries. It partnered with Anglo-Dutch Unilever Corporation, one of the world's largest buyers of frozen fish and producer of well-known frozen fish products under such brands as Iglo, Bird's Eye and Gorton's, they were interested in long-term fish stock sustainability to ensure a future for its successful fish business. While these organizations may have different motivations, they possessed a shared objective – "to ensure the long-term viability of global fish populations and the health of the marine ecosystems on which they depend" (Sutton, 1998 p. 133).

The MSC, established in early 1997, is an independent non-profit, non-governmental body. The MSC continues in developing a broad set of biological, environmental, economic and social principles and criteria for sustainable fishing through worldwide consultations and as Mikalsen and Jentoft (2001 p. 288) proclaim, the MSC initiative is a strategy to mobilize and empower consumers as stakeholders to improve management practices. According to von Zharen (1999 p. 19) the MSC hosted an open series of regional and national consultations and workshops around the world to "refine and strengthen the principles and agree on a process for international implementation." The MSC accredits independent certification firms that apply the criteria, or standards, to individual fisheries. Products will come from fisheries that are not exhibiting signs of overfishing, and only fisheries meeting these standards will be eligible for certification. Products made from fish caught in accordance with MSC standards will receive an "on-pack" logo similar in concept to the "dolphin-safe" logo appearing on cans of tuna (see also Teisl et al., 2002; NOAA, 2000 and 2002; Joseph, 1994). As with a "green seal" certification of products determined to be environmentally sound, the logo would assist organizations and individuals in making environmentally responsible choices. A label represents that the fish are taken from sustainably managed fisheries. Seafood companies are encouraged to join sustainable buyers' groups and to make commitments to purchase fish products from certified sources. This element necessitates, then, a guarantee that an organization has integrated VEMS precepts that supports sustainability and that it will form partnerships whenever possible to encourage sustainable perspectives (von Zharen, 1999 p. 19). Ultimately, only fisheries meeting specific standards shall be eligible for certification by independent, accredited certifying firms. Seafood companies will be encouraged to make commitments to purchase fish products from certified sources only. By analogy products from fisheries certified to ISO 14000 series standards may be marked with a logo on the package. This would theoretically provide seafood consumers selection of fish products that come from a verifiable sustainable source (Sutton, 1998; see: e.g. Stehr Group, 2005; Gable, 2004 and 2003).

Allison (2001 p. 945) wrote about market incentives for sustainable U.S. fisheries remarking that in 1997, The World Wide Fund for (WWF) and the Unilever Corporation launched the Marine Stewardship Council (MSC) to harness market forces and the power of consumer choice in favor of sustainable, well-managed fisheries. Certification on biological, environmental, economic and social criteria is carried out by independent firms. Products are marked with an MSC logo or equivalent to allow consumers to select those that come from an acknowledged sustainable source (see also Sutton, 1998 p. 133).

Voluntary market-based measures appear likely to become more readily and widely adopted and could improve the management of export-orientated fisheries in developing countries (and many developed-country fisheries). They may also have the indirect effect of reducing the negative environmental and socio-economic impacts of competition between 'industrial' and 'artisanal' fisheries in many LME's by forcing the larger-scale producers to comply with policies protecting small-scale fishing interests, in order to gain certification (Allison, 2001; p. 946).

The creation of the MSC or equivalent, such as ISO 14020, has the potential to significantly alter fishing practices everywhere in favor of more sustainable, less destructive fisheries. When Unilever and other major seafood companies make commitments to buy their fish products only from well-managed and MSC-certified fisheries, many in the fishing industry will be compelled to modify their present practices (see e.g. Pauly et al., 2002; Myers and Worm, 2005 and 2003; Raloff, 2005). Governments, laws, and treaties aside, the market itself will begin to determine the means of fish production. The costs of environmental protection and the development of sustainable fisheries will thus be distributed through the market chain, rather than falling disproportionately on the shoulders of one or more sectors (Sutton, 1998 p. 133).

Roheim (2003 p. 96) reports that the first fishery certified to Marine Stewardship Council (MSC) standards was in 2000. She suggests that consumers who purchase ecolabeled fishery products support healthier large marine ecosystems. It should be noted however, that Hannesson (2004

p. 345) argues that many of the MSC ecosystem management (eco-label) principles have little or nothing to do with increasing the long-term supplies of fish at maximum sustainable yield, and that they are open to interpretation (see also: Mansfield, 2003).

The role of society, through eco-labelling, ethical trade, and NGO lobbying and representation has yet to be felt as a significant governing force though, however, it seems likely to become more important with the prospective transition to rights-based fishing or, "dedicated access privileges" in the USA (see for example, Allison, 2001 p. 947; Sutinen et al., 2000; Sutinen et al., 2005).

For example, Allison (2001 p. 948) reports that small-scale fisherfolks' representative organizations in India have been successful in capturing the attention of their own government and international donors and NGOs in supporting their interests over those of the 'industrial' sector. This may herald and foster an era of greater emphasis on the socio-economic goals of fishery science and management and a return to ecologically sustainable means of exploitation (McCay, 2004).

Nevertheless, in a conservation partnership, "the MSC sets out broad principles of sustainable fishing and specific standards for individual fisheries. The purpose of the independent, nonprofit, nongovernmental membership body is to halt global fish population declines by promoting market-based incentives for sustainable fishing modeled on approaches to sustainable forestry. The MSC creates a new standard for fish products from sustainable sources and spells out specific certifiable standards for individual fisheries" (von Zharen, 1999 p. 18; von Zharen, 1998 p. 94).

Discussion: Voluntary Environmental Management System (VEMS) Certification in an LME Framework

In general terms, the ISO or MSC eco-label simply confirms that the product is what it says it is (see: Stehr Group, 2005; LeBlanc, 2003). Also certified is the documentation describing the process by which the product came about. If it were specifically applied to LME fisheries, however, and United Nations Food and Agricultural Organization (FAO) "Code of Conduct of Responsible Fisheries" voluntary criteria were employed by example, the process could certify and label the sustainability of a fishery an institutional ecological practice (Sproul, 1998b p. 143). The ISO 14000 series on environmental management includes both organizational evaluation and product/process evaluation practices. These continue to be refined by the ISO TC 207 with the first "new and improved" series designated as ISO 14000:2004 released on November 15th 2004 (Table 4). It is important to note that the international eco-labelling protocol is an important aspect of ISO product evaluation that is actively being pursued in many international LME settings (e.g. Stehr Group, 2005).

A coordinated approach throughout LME's would ensure a more rapid worldwide acceptance of this important initiative to incorporate environmental practice within the fishing industry's production and services cycle (Sproul, 1998b p. 144). In addition, it would provide political and economic incentives for conveying transparently that information in a consistent and, concise manner to all stakeholders and consumers. In the absence of a unified advance, several potentially conflicting fishery certification initiatives will emerge and confuse the public and dilute or destroy the credibility of the practice for all (by analogy for a review see e.g. Joseph, 1994). The stage is potentially set for such a confrontation in fisheries certification. Sproul (1998b p. 144) advocates that the existing ISO 14000 protocol and Marine Stewardship Council must coordinate their efforts in this endeavor. In fisheries certification, multiple standardization schemes such as those occurring in forestry can prove counter-productive, and ought to be avoided (Sproul, 1998b p. 144; see also Swallow and Sedjo, 2000).

Using the dolphin-friendly tuna product to demonstrate that higher prices are not necessary, fish processors and retailers are not expected to charge a premium for sustainably-sourced fish. The first U.S.-based company to adopt the MSC program illustrates the diversity of participants: Special Expeditions is a tour company who pledged to serve sustainably-caught fish on its cruises (von Zharen, 1998 p. 93). Therefore, it may seem that a primary requirement among many of a holistic marine species management strategy is VEMS certification (see Figure 15). The planning process for marine life management also can be enhanced through numerous information-planning tools, such as geographic information systems (GIS) technology, to integrate data from a variety of sources (Zeller et al., 2005).

Often regarded in terms of allocation between competing parts of the fishery sector, trade-offs between species are seen as a political issue in single-species management (Pitcher and Pauly, 1998 p. 325). Thus, von Zharen (1999 p. 21) remarks that the pace of shifting the approach from single-species management to ecosystem-oriented sustainability must quicken. To carry out effective and innovative environmental management programs all have a stake in developing the commitment, knowledge, and technology. Global large marine ecosystem management with a VEMS process is a difficult challenge, one that requires special initiatives, management, and a vision towards global stewardship. As part of ecosystem-oriented management, all interacting species are included in a multispecies resource evaluation (Pitcher and Pauly, 1998 p. 325).

From a large marine ecosystem (LME) perspective, principles for effective environmental standards can be drawn from existing negotiated voluntary governance mechanisms, such as the FAO Code of Conduct for Responsible Fisheries, and applied to individual firms involved in fishing or seafood production and export, or to a whole fishery through fisheries associations (Allison, 2001 p. 946).

Table 1. Prospective Contents of an Ecosystem Area Management Plan for Sustainable Fisheries. The following items and content are suggested for the Ecosystem Area Management Plan, source: adapted and modified from "Core Ecosystem and Fishery Management International Performance Standard for the Marine Aquarium Trade" (see: http://macweb.inets.com) online available July 30, 2005. Alverson (2004 p. 647) reiterates that as a starting point "an initial step may require only that managers consider how the harvesting of one species might impact other species in the ecosystem."

- Title of the Ecosystem Area Management Plan;
- Geographical area of operation of the marine fishery, and the jurisdiction under which it falls;
- History of collection and management;
- Particulars of the stakeholders with interests in the marine fishery;
- Details of consultations leading to the management of the marine fishery;
- Arrangements for on-going consultations with stakeholders;
- Details of decision-making process or processes, including the recognized participants;
- Goals and objectives for the marine fishery to include:
  - Resource;
  - Environmental and ecological;
  - Biological diversity;
  - Technological and;
  - Socio-economic items and/or content;
- List of the marine organisms caught and the quantities and sizes involved;
- Overview of fishing methods;
- Basic description of the aquatic ecosystem, its status, and any particularly sensitive areas, features, or species influencing or affected by the marine commercial and/or recreational fishery;
- Description of other legitimate uses that impact on the fishing area ecosystem(s);
- Details of those individuals or groups granted rights of access to the marine fishery, and particulars of the nature of those rights (dedicated access privileges in the U.S.);
- Basic description for measures agreed upon for the regulation of the collection and fishing of marine organisms within the designated ecosystem area. These may include general and specific measures, precautionary measures, contingency plans, mechanisms for emergency decisions, etc.
- Details of any critical environments (essential fish habitat (EFH)) or sources of concern and required actions to address them;
- Arrangements and responsibilities for regular monitoring, control and surveillance, and enforcement. New management, monitoring, and surveillance methods that prove to be beneficial to minimizing ecosystem impact and organism mortality should be adopted.
- Details of any planned education and training for stakeholders;
- Date and nature of next review and audit of the Ecosystem Area Management Plan.

Table 2. Examples of ISO 14000 voluntary environmental management systems and tools. Adapted and modified from information available at http://www.iso.ch: see also Gable, (2003, p. 439).

- ISO 14001 requires the preparation of VEMS audits.
- The guidance for carrying out such audits can be found in ISO 14010, ISO 14011, and ISO 14012 documentation.
- ISO 14001, via guidelines found in ISO 14031, requires an organization to monitor and measure the environmental performance of its activities. In the case at hand, for example, the organization's adherence to *all* 10 National Standards found in the Sustainable Fisheries Act of 1996 (P.L. 104-297).
- ISO 14001, via guidelines and standards found in ISO 14020 and ISO 14040, requires an organization to consider and take into account the identification and analysis of the environmental aspects of its products and/or services, in part through labels and declarations. Certification as "ISO 14000 compliant" is also available and desirable.

Table 3. Some examples of ISO 14001 VEMS environmental policy options, adapted and modified from Ritzert (2000, p. 73), compare with Table 4.

***Process Option* Questions**	**ISO 14001: 1996 VEMS Requirements**
Who will be involved in developing the policy?	"(T)op management shall define" – but the standard does not restrict involvement to top management.
How will the process of writing the policy be defined/described?	No specific requirements on what process should be used, but subject to requirements for document control (see below). "Procedures and responsibilities shall be established and maintained concerning the creation and modification…"
How will the process involve aspects and impacts information?	Policy must be "appropriate to" impacts. Implied requirement to use impacts information in setting policy.
How should the policy be made available to the public? Via an annual report? Website? Newspaper? Posting in public areas of facilities? Available on request?	Policy must be available to the public; no requirement on how. Requirement is passive; it does not require action to ensure that the policy is communicated.
What should be included in the policy statement? Other commitments? Language addressing relationship to impacts? Performance intentions? Guiding principles?	Typically three requirements (see also Figures 1-25): • Must be "appropriate" to environmental impacts of activities, products, and services. • Must include commitments to continual improvement, and compliance. • Must provide framework for setting objectives and targets.
What format should be used for the policy? Should there be more than one format for different audiences? Should it be signed?	Only format requirement is that the policy be documented. ISO 14001 allows paper or electronic format. Since the policy statement is a VEMS document, it must be managed under the document control system; the requirements of Clause 4.4.5 apply (including requirements regarding date, current version, etc.). From a practical standpoint, this implies a need for both controlled and uncontrolled copies of the policy statement.

Table 4. Comparison ISO 14000:1996 and ISO 14000:2004, *open literature source*: (EMSL 2005) Environmental Management System Library (EMSL) Road to Successful (Voluntary) Environmental Management System Implementation. Online at http://p2library.nfesc.navy.mil/ems/index.html.

Element	ISO 14000:2004 Key Changes
4.1 General Requirements	➢ New requirements to: • Document, implement and continually improve the VEMS. • Determine how the organization will fulfill the requirements of ISO 14001. • Define and document the scope of the VEMS.
4.2 Environmental Policy	➢ New requirement to define the Policy within the scope of the VEMS. ➢ Limitation of compliance commitment to those legal and other requirements related to the environmental aspects. ➢ Policy must be communicated to others working in support of the organization, as well as to employees. Alternate forms of communication, such as guidance on specific sections of the Policy could be used to communicate with contractors and others.
4.3.1 Environmental aspects	➢ The aspects procedure must be implemented. ➢ The requirement to identify aspects is limited to those within the scope of the VEMS. ➢ A new requirement to include planned or new developments and activities within the aspects process (formerly under 4.3.4). ➢ New requirement for documentation of the information from the aspects identification and significance determination processes. ➢ Significant aspects are to be considered in establishing, implementing and maintaining the VEMS.
4.3.2 Legal and other requirements	➢ The procedures must be implemented ➢ New requirement to determine the applicability of legal/other requirements to environmental aspects. ➢ New requirement to consider environmental legal and other requirements in development, implementation and maintenance of the full VEMS
4.3.3 Objectives, targets and programme(s) (formerly Objectives and targets)	➢ Objectives and targets must be documented and implemented. ➢ Objectives and targets should be measurable ➢ Objectives and targets should be consistent with legal and other requirements. ➢ Objectives and targets should be consistent with the commitment to continual improvement. ➢ Text from 1996 element 4.3.4 *Environmental management programme(s)* has been moved to this element.
4.3.4 Environmental management programme(s)	➢ The requirement to establish programs has been moved to 4.3.3 Objectives, targets and programme(s) ➢ The final paragraph referencing new developments was moved to 4.3.1 Environmental aspects
4.4.1 Resources, roles, responsibility and authority (Formerly Structure and responsibility)	➢ New requirement that management provide resources for establishing, implementing, maintaining and improving the VEMS. ➢ Expands list of resources to include organizational infrastructure, as well as people, technology and dollars. ➢ Management representative should include recommendations for improvement when reporting to top management on the performance of the VEMS.

Table 4 continued.

4.4.2 Competence, training and awareness (Formerly Training, awareness and competence	➢ Requirements apply to persons working in support of the organization, not just to employees. Contractors, volunteers etc. also must be competent to perform tasks associated with significant environmental impacts. ➢ Records of training or other action must be kept to demonstrate everyone's competence. ➢ Specific requirement to identify training needs relevant to environmental aspects and the VEMS. ➢ Awareness procedure must be implemented
4.4.3 Communication	➢ Procedure should be implemented ➢ New requirement to decide whether or not to communicate externally about significant aspects and to implement the external communication, if the answer is yes.
4.4.4 Documentation (Formerly Environmental management system documentation)	➢ New requirement for documentation to include: • The environmental policy, objectives and targets, • Description of the scope of the VEMS • Descriptions of elements of the VEMS including their interaction and references to related documents, • Documents, including records, required by the Standard, and • Documents, including records, needed to manage processes associated with significant aspects
4.4.5 Control of documents (formerly Document control)	➢ Identifies records as a special type of document requiring control. ➢ Expands applicability to all documents required by the VEMS, as well as by the Standard ➢ New requirement for identification and control of documents of external origin (*e.g*. permits) necessary to the VEMS
4.4.6 Operational Control	➢ No significant changes. Addition of the requirement to implement the procedure. ➢ Subtle word change to communicate applicable procedures and requirements.
4.47 Emergency preparedness and response	➢ No significant changes. Addition of the requirement to implement the procedure
4.5.1 Monitoring and Measurement	➢ Change from *recording information to track performance*, which implies records of results achieved or activities already performed, to *documenting information to monitor performance*, which has more immediacy ➢ Requirement that *calibrated or verified equipment is used* rather than that *equipment shall be calibrated* again implies immediacy. ➢ The requirement for periodic evaluation of compliance with environmental legislation and regulations has been moved to the new element 4.5.2
4.5.2 Evaluation of compliance (NEW ELEMENT)	➢ Evaluation of compliance now includes both applicable legal requirements and other requirements to which an organization subscribes. ➢ New requirement to keep records of these evaluation(s).
4.5.3 Nonconformity, corrective action and preventive action (Formerly 4.5.2 Nonconformance and corrective and preventive action	➢ This element clearly states requirements for: • Implementing the procedure • Investigation and determination of the causes of nonconformance to avoid recurrence. • Evaluation of the need for actions to prevent occurrence/recurrence • Records of the results of corrective and/or preventive actions • Review of the effectiveness of the actions taken

Table 4 continued.

4.5.4 Control of records (formerly 4.5.3 Records)	➢ New requirement for records to demonstrate results achieved, *e.g.*, results of corrective action, programs to achieve objectives and targets etc. ➢ No longer specifies training records, audit results and reviews. Explicit requirements for these records are incorporated into the appropriate element. ➢ Broader interpretation of records required, including records to demonstrate conformity with the requirements of the VEMS.
4.5.5 Internal audit (Formerly 4.5.4 Environmental management system audit)	➢ New emphasis on planning the schedule, procedures, conduct, reporting and record keeping for internal audits. ➢ New responsibility for retaining records associated with the audit. ➢ New responsibility for selecting auditors and conducting audits that ensure the objectivity and impartiality of the audit process. ➢ Annex A references ISO 19011 guidance on auditing of VEMS.
4.6 Management Review	➢ Specifies inputs to the management review process including: • Results of internal audits and evaluations of compliance with legal and other requirements, • Communication from external interested parties, including complaints, • The environmental performance of the organization, • The extent to which objectives and targets have been met, • The status of preventive and corrective actions, • Follow-up actions from previous management reviews, • Changing circumstances including developments in legal and other requirements, and • Recommendations for improvement. ➢ Specifies outputs of the management review including decisions and actions regarding possible changes to: • The environmental policy • Objectives • Targets • Other elements of the VEMS

Table 5. Summary of suggested reasons for the inadequacy or failure of fisheries management in either a domestic or international setting or both. Many or all of these may apply to an individual directed fishery. Source: adapted and modified from Allison (2001 p. 936).

1. "Dedicated access privileges" and ownership regimes unsuitable or poorly defined, leading to 'Tragedy of the Commons.'
2. Lack of political will to limit fishing, due to the major economic importance of the fisheries sector in some localities.
3. Conflict with other uses of the ocean, principally as a 'common sink' for discharge of pollutants and degradation (i.e. filling in) of key coastal habitats (e.g. salt marsh, mangroves, and also coral reefs) leading to "essential fish habitat" degradation affecting fishery yields.
4. Inadequate financing and capacity to enforce a nations fishery and ocean laws, allowing circumvention of management aimed at sustaining stocks; also problems with monitoring "high seas" resources.
5. Prevalence of production-orientated resource 'development' paradigm, leading to neglect of sustainability issues.
6. Subsidized over-capacity in fishing fleets; subsidies mask signals of resource scarcity.
7. Failure to manage the consequences of rapid technological and political change.
8. Failure to specify and/or adhere to long-term management objectives and goals to allow for rational sector-wide planning and sustainability.
9. Lack of resource-user involvement in management and policy making, i.e., co-management protocols.
10. Inadequate or incorrect scientific advice on sustainable harvesting levels and a management system that is under-reliant on proper scientific advice.
11. Insufficient consideration of social, economic and political dimensions of sustainable fisheries by fisheries extension and/or advisory services.
12. Value of marine ecosystem services not taken into account in the prevalent single-species management approaches.
13. Pelagic and transboundary nature of fish stocks – several commercial and recreational species move through multi-governed spaces.
14. Failure to adequately account for natural (climate-induced) variability in resource productivity and sustainability in most management/development plans.

Table 6. Selected prospective stages in the policy orientation process as part of an ecosystem-oriented LME module-approach to fisheries management and sustainability. Adapted and modified from, e.g., Jones (1984); Gable, (2003 and 2004) and references cited therein. The **bold** highlighted stages below indicate "significant scientific input for this activity" (Burroughs, 1996).

- **Definition of problems in society (problem definition)**
- Initiation/invention may include preliminary investigation of management concepts
- Aggregation of concerned individuals, e.g., stakeholders, also public awareness
- Organization or initiation, e.g., stakeholders consensus building
- Representation, access to decision makers maintained
- **Agenda setting**
- **Formulation of proposals (by government)**
- Legitimization of program by elected government
- Preparation of a program may include pilot projects as a potential pre-test
- Estimation may include a more thorough assessment of management concepts
- Selection may provide benefits by reducing uncertainty about various options
- **Prediction of policy decisions in planning and managing natural resources**
- Budgeting for governmental program and (formal adoption of program)
- Adoption of organizational and legal mechanisms
- **Implementation of government program by key actors**
- **Evaluation of program**
- Refining and consolidating, including, e.g., program monitoring
- Adjustment and/or termination, including how adjustments come about

Table 7. National Standards to provide for the conservation and management of fisheries from the U.S. Sustainable Fisheries Act of 1996, Public Law 104-297 October 11, this law is likely to be amended by Congress in 2006

1. Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.
2. Conservation and management measures shall be based on the best scientific information available.
3. To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.
4. Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be
   (a) fair and equitable to all such fishermen;
   (b) reasonably calculated to promote conservation; and
   (c) carried out in such manner that no particular individual, corporation or other entity acquires an excessive share of such privileges.
5. Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measures shall have economic allocation as its sole purpose.
6. Conservation and management measures shall take into account and allow for variations among, and contingencies in fisheries, fishery resources, and catches.
7. Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.
8. Conservation measures shall, consistent with the conservation requirement of the Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to
   (a) provide for the sustained participation of such communities, and
   (b) to the extent practicable, minimize adverse economic impacts on such communities.
9. Conservation and management measures shall, to the extent practicable
   (a) minimize by-catch and
   (b) to the extent by-catch cannot be avoided, minimize the mortality of such by-catch.
10. Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

Note: National Standards 8-10 were added in October 1996 via Public Law 104-297. National Standards 1-4 were inserted via Public Law 98-623, which were amendments to the initial Magnuson-Stevens Fishery Conservation and Management Act (Public Law 94-265). It is also important to mention that via Public Law 97-453, section 301(b) Guidelines – the Secretary of Commerce "shall establish advisory guidelines (which shall not have the force and effect of law), based on the national standards, to assist in the development of fishery management plans." Adapted and modified from Darcy and Matlock, (1999) and information from http://www .nefsc.noaa.gov/magact/mag3.html)

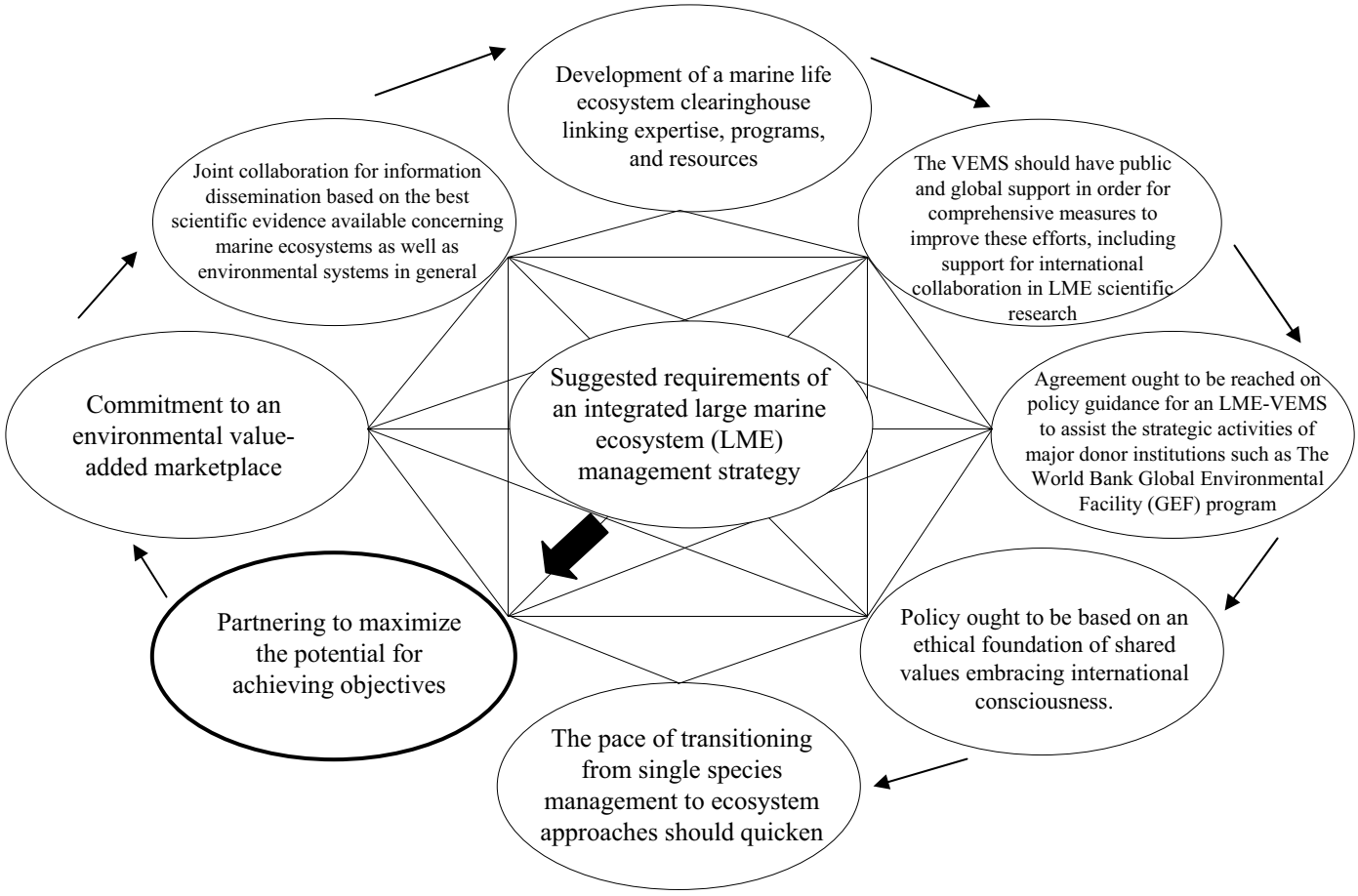

Figure 1. Suggested requirements of an integrated large marine ecosystem (LME) management strategy as a part of the socio-economic and governance modules in the LME approach, adopted and modified from von Zharen (1999 pp. 17-21). Regarding "partnering" outcomes of the World Summit on Sustainable Development (WSSD; Johannesburg, 2002) Hens and Nath (2003, p. 7) discuss the advent of Type II Partnerships culminating from that international symposium; these are "projects that allow civil society to contribute to the implementation of sustainable development." This corresponds to humans as an integral part of the marine ecosystem (Sherman, 2005). "Partnerships have become state-of-the-art because of the confluence of two trends, namely the increasing acceptance of the fundamental tenets of ecosystem management and the changing nature and scale of government" (Michaels et al., 1999 p. 159). The WSSD Type II Partnerships articulated in the paper by Hens and Nath (2003 p. 32) are defined "as a series of implementation partnerships and commitments involving many stakeholders ... [t]hese would help translate the multilaterally negotiated and agreed outcomes into concrete actions by interested governments, international organizations and major groups." For our purposes, the "major groups" would include fishing vessel captains, operators, and their crew, fisherfolk organizations, seafood processors and distributors, gear makers, fishery management councils in the U.S., etc. Masood et al., (1997 p. 108) reports that in the offshore Georges Bank area researchers there were among the first in the U.S. to involve fisherfolk in scientific studies. A set of "guidelines" were developed for Type II Partnerships indicating that they should, *inter alia*, "be voluntary in nature" and feature "integrated economic, social and environmental dimensions of sustainable development." And, these partnerships should "have a system of accountability, including arrangements for monitoring progress" (Hens and Nath, 2003 p. 33). Therefore, it is hypothesized here that "civil society" (major groups) can make project-wise contribution to the implementation of sustainable development through an embrace of voluntary environmental management systems (VEMS) envisioned in the ISO 14001 VEMS framework or equivalent consensus-based paradigms (see also Duda, 2005; Connaughton, 2002a&b). A VEMS is not a substitute for government commitments found in legislative mandates nor is it subject to negotiation (see e.g. Hens and Nath, 2003 pp. 32 & 33). Further, because implementation of sustainable development "is not a core activity of business or industry" (Hens and Nath, 2003 p. 33), these authors also speculate that "scientists engaged in research on sustainable development have much to gain from Type II Partnership networks." Therefore by example, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) "Broad Agency Announcement" for proposals addressing several research topics related to Northeast U.S. fisheries (Northwest Atlantic Ocean) under the Cooperative Research Partners Initiative can be considered just such a Type II Partnership as envisioned in Johannesburg in September 2002. For example, the "objectives of these projects are to encourage cooperative research between fisheries managers, scientists, and industry members" (see: http://www.nero.noaa.gov/statefedoff/coopresearch/baa4.htm ., Online Available June 18, 2005). The Cooperative Research Partners Program's announcement for 2005 included "partnerships" research on *inter alia*, "topics relevant to ecosystem-based fisheries management" as well as studies on the "socio-economic aspects of marine recreational and commercial fisheries in the Northeast" and to "develop and implement strategies for enhancing safety at sea" (National Standard 10 of the U.S. Sustainable Fisheries Act of 1996; e.g. Table 7). Another of the research topics in the 2005 solicitation involves "studies on fishing practices… or ways to reduce the bycatch of groundfish (re: haddock) in the herring fishery." It is this contemporary topic that is discussed in Appendix 1 to this manuscript as a representative example of an industry based voluntary environmental management system ISO 14001 approach that encompasses relevancy for "ecosystem-based fisheries management" as well.

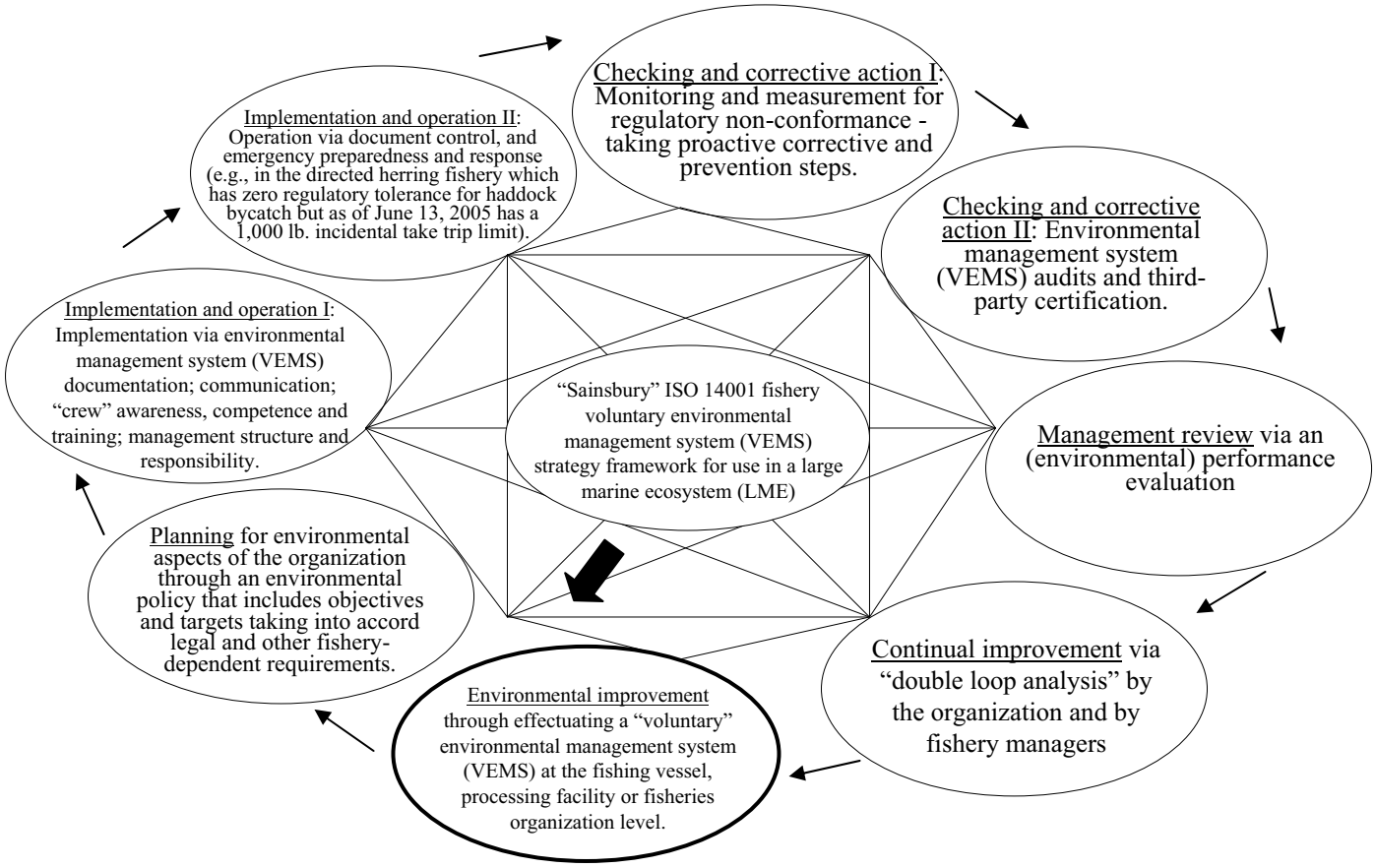

Figure 2. Depiction of the "Sainsbury" ISO 14001 fishery voluntary environmental management system (VEMS) strategy framework for use in an LME. It comes under the socio-economic, governance, fish and fisheries as well as pollution and ecosystem health LME modules (see also Figure 11). Adapted and modified from Sainsbury et al., (2000 p. 732); Sainsbury and Sumaila, (2003); see also: Quazi et. al., (2001 p. 527).

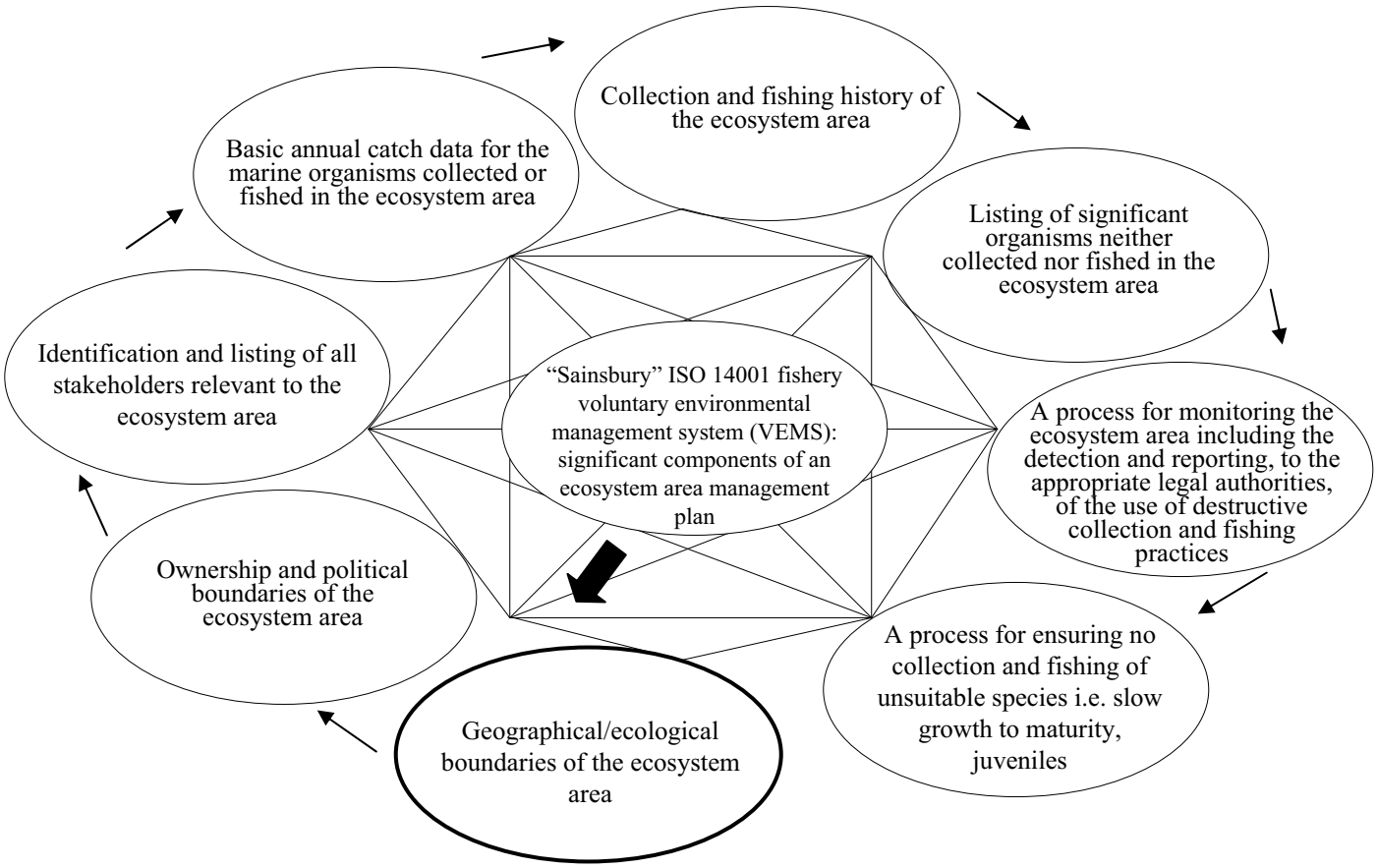

Figure 3. Depiction of the "Sainsbury" ISO 14001 fishery voluntary environmental management system (VEMS) strategy containing significant components of an ecosystem area management plan. It comes under the socio-economic, governance, fish and fisheries as well as pollution and ecosystem health LME modules (see also Figure 11). Adapted and modified from Sainsbury et al., (2000 p. 732); Sainsbury and Sumaila, (2003); see also: Quazi et al., (2001 p. 527), and information available from the Marine Aquarium Council headquartered in Honolulu, Hawaii (see http://macweb.inets.com) as cited in Shuman et al., (2004).

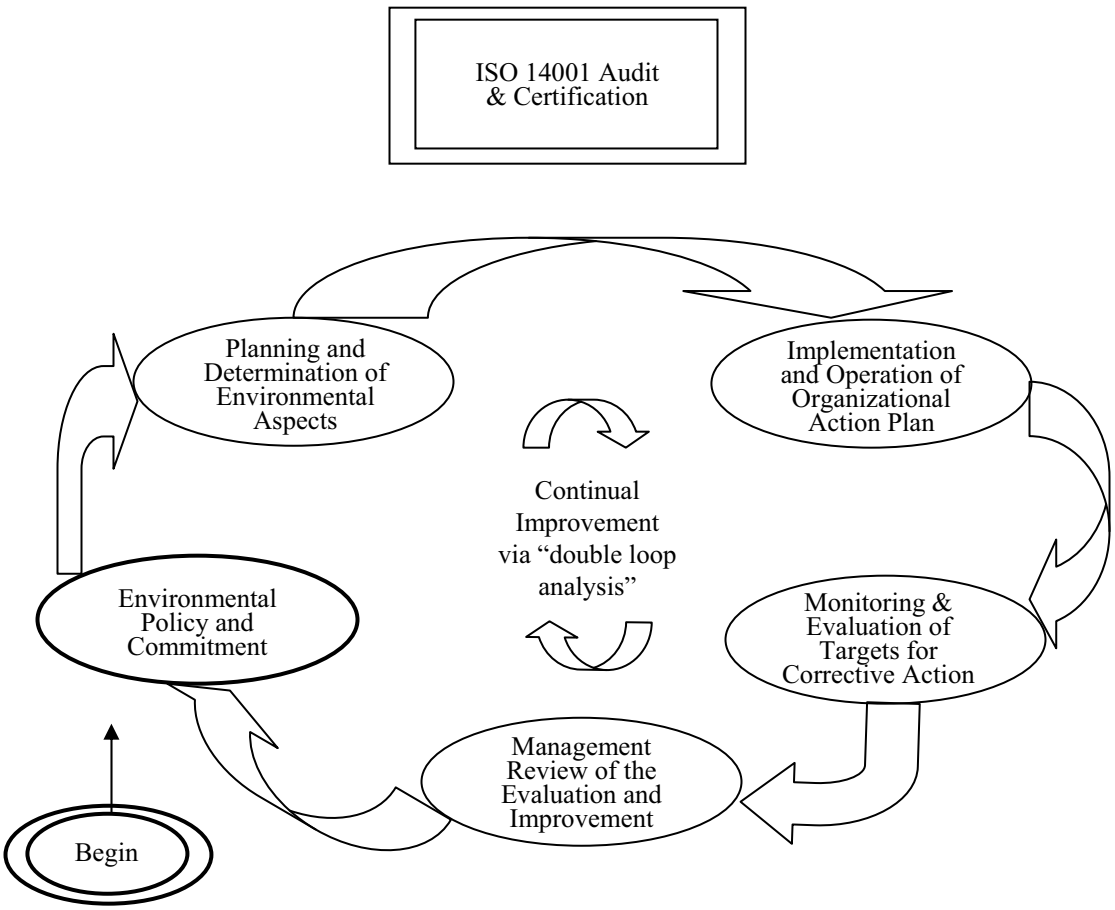

Figure 4. The depiction of a living marine resources ISO 14001 voluntary environmental management system (VEMS) for utilization in a large marine ecosystem (LME) featuring "double loop analysis" as identified by Darnall (2001, p. 2); Quasi et. al.; (2001 p. 527); see also: Montabon et. al., (2000). Hormozi (1997 p. 35) states that these steps comprise clauses 4.1 to 4.5 of ISO 14004, the guidance standard. A continuous process of learning may foster conditions for strategic reorientations guided by adaptive management principles (see: Benezech et al., 2001 p. 1406).

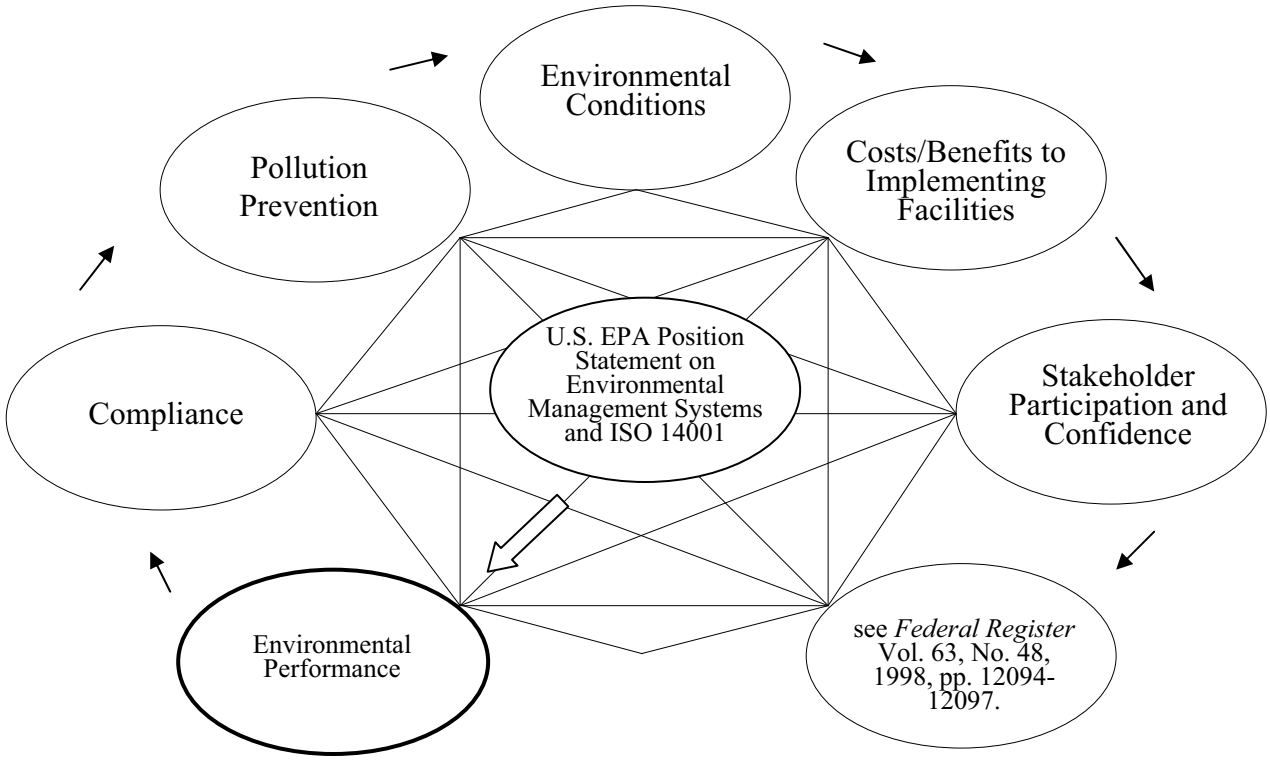

Figure 5. U.S. Environmental Protection Agency stance on (voluntary) environmental management systems (VEMS) and ISO 14001, see *Federal Register* Vol. 63 (48), 1998, pp. 12094-12097; cited as EPA 1998a, see also EPA, (1998b); and Johnson (2004).

Marine voluntary environmental management systems (VEMS): A continuous cycle

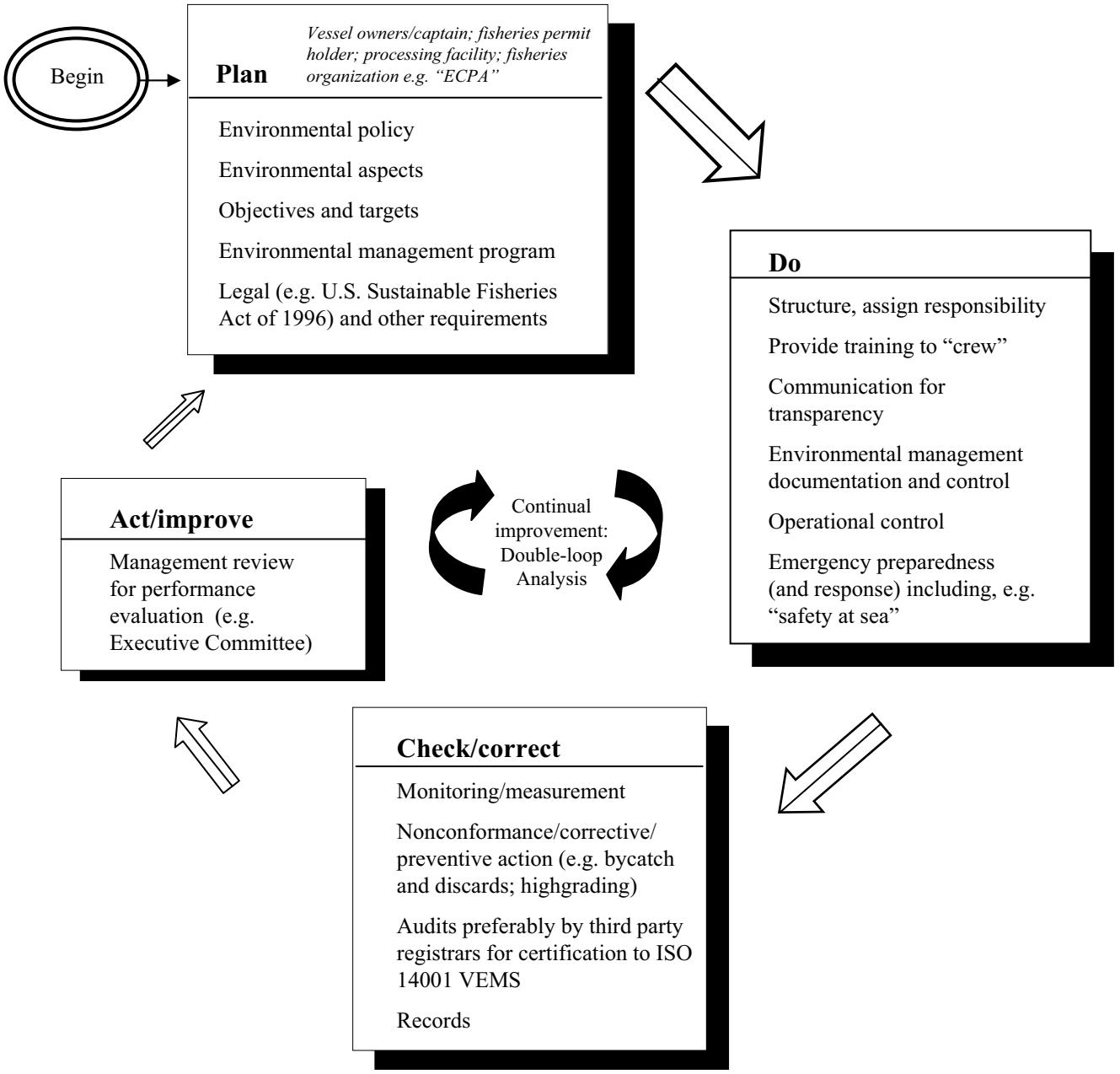

Figure 6. A voluntary environmental management system is a part of an organization's overall synoptic approach to strategic business planning. As illustrated in the classic management cycle of planning, doing, checking/ correcting, and acting/improving, environmental management includes several steps in a continuous process designed to improve an organization's environmental "footprint" and operating conditions. Here, fisheries is particularly noted, and the 10 National Standards found in the U.S. Sustainable Fisheries Act (Public Law No. 104-297) are particularly applicable (see Table 7). By example, the United Nations voluntary Code of Conduct for Responsible Fishing could be utilized as a "best practice" in an international large marine ecosystem (LME) setting where 90-95% of the world's commercial catch of fisheries is harvested (see: Sherman, 2005). Source: Adapted and modified from Begley (1996a p. 301a) The reader will note many similarities to the "Sainsbury" ISO 14001 VEMS approach depicted in Figure 2; see also Sainsbury et. al., (2000, p. 732). The cycle is also applicable in a modified way for the regulators, e.g. New England Fishery Management Council, Atlantic States Marine Fisheries Commission and so forth. According to Darnall (2001 p. 2) the ISO 14001 is based on a 1931 model towards achieving continuous improvement. The East Coast Pelagic Association (ECPA) of Camden, Maine is cited as a representative example of a fisheries organization.

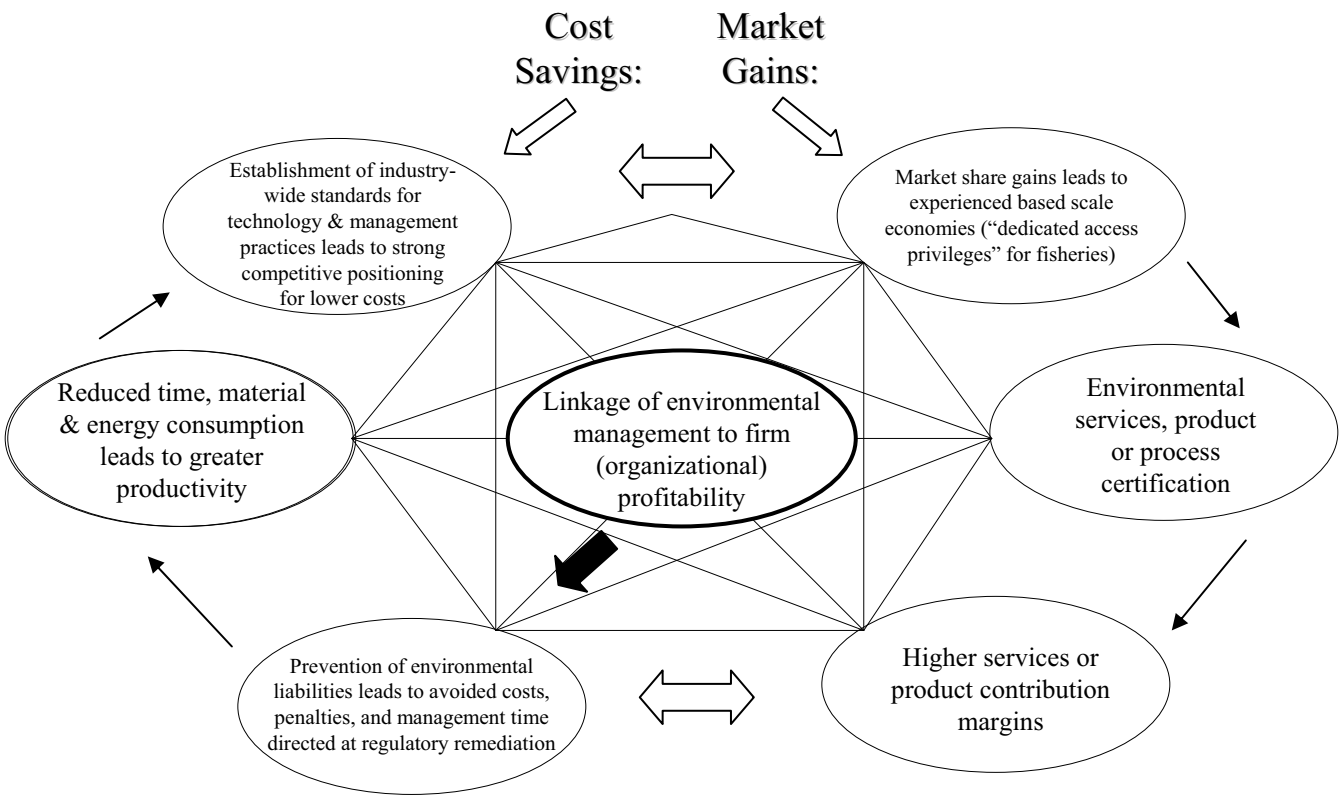

Figure 7. According to Klassen and McLaughlin (1996) the linkage of environmental management to firm profitability encompasses market gains with cost savings. Strong environmental management systems coupled to organizational operations designed to minimize environmental impact(s) leads to improved (environmental) efficiency. Together they provide improved financial performance. According to Christmann (2000 p. 666) "Firms that are able to accumulate resources and capabilities that are rare, valuable, nonsubstitutable, and imperfectly imitable will achieve an advantage over competitors." In her study, she applied the resource-based view of the firm which incorporated the *concept of complementary assets* "which are resources or capabilities that allow firms to capture the profits associated with a strategy, technology or innovation." An ISO 14000 series voluntary environmental management system (VEMS) strategy is just such an innovation. "In the context of environmental strategies, complementary assets can be defined as assets that are required to gain competitive advantage from the implementation of the best practices of environmental management" (Christmann, 2000 p. 666).

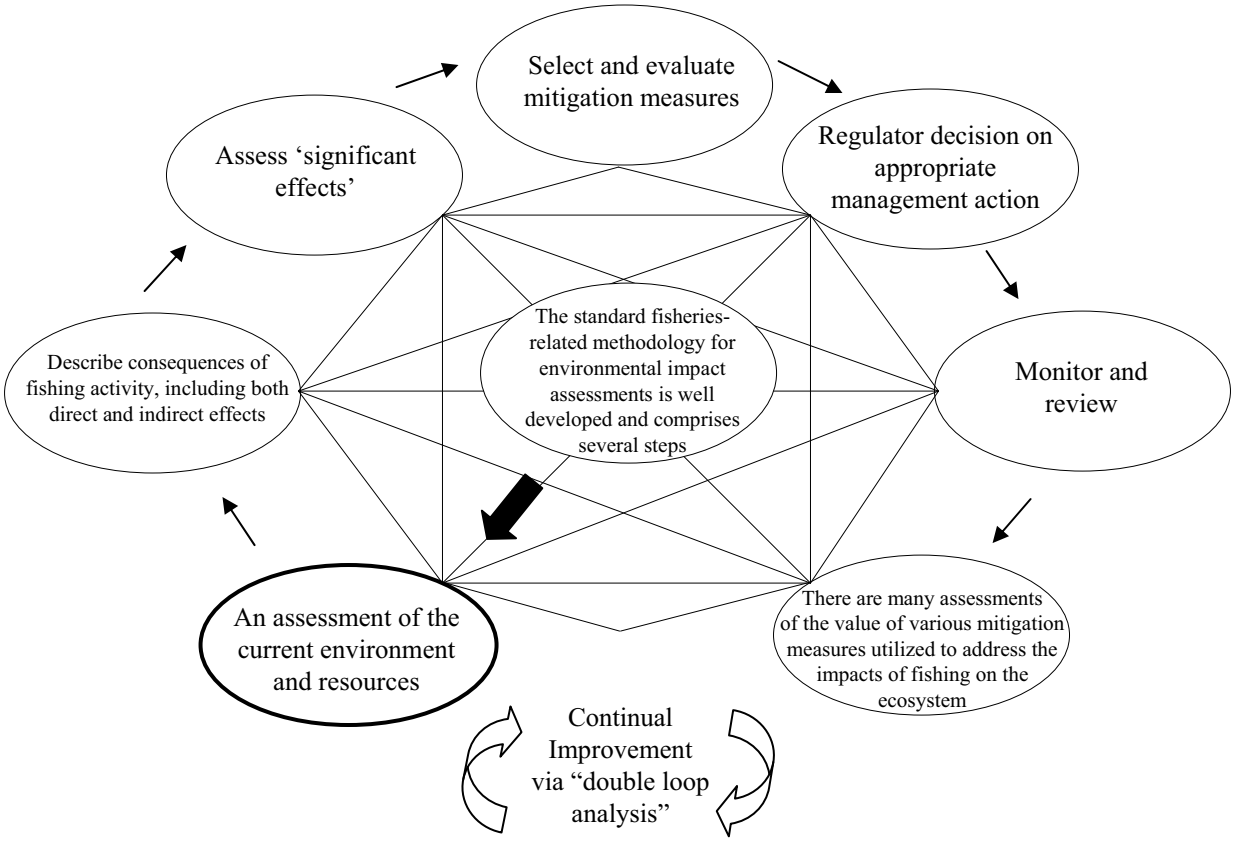

Figure 8. According to Frid et al., (2005 p. 467) the standard fisheries-related methodology for environmental impact assessments (EIA) is well developed and comprises several steps.

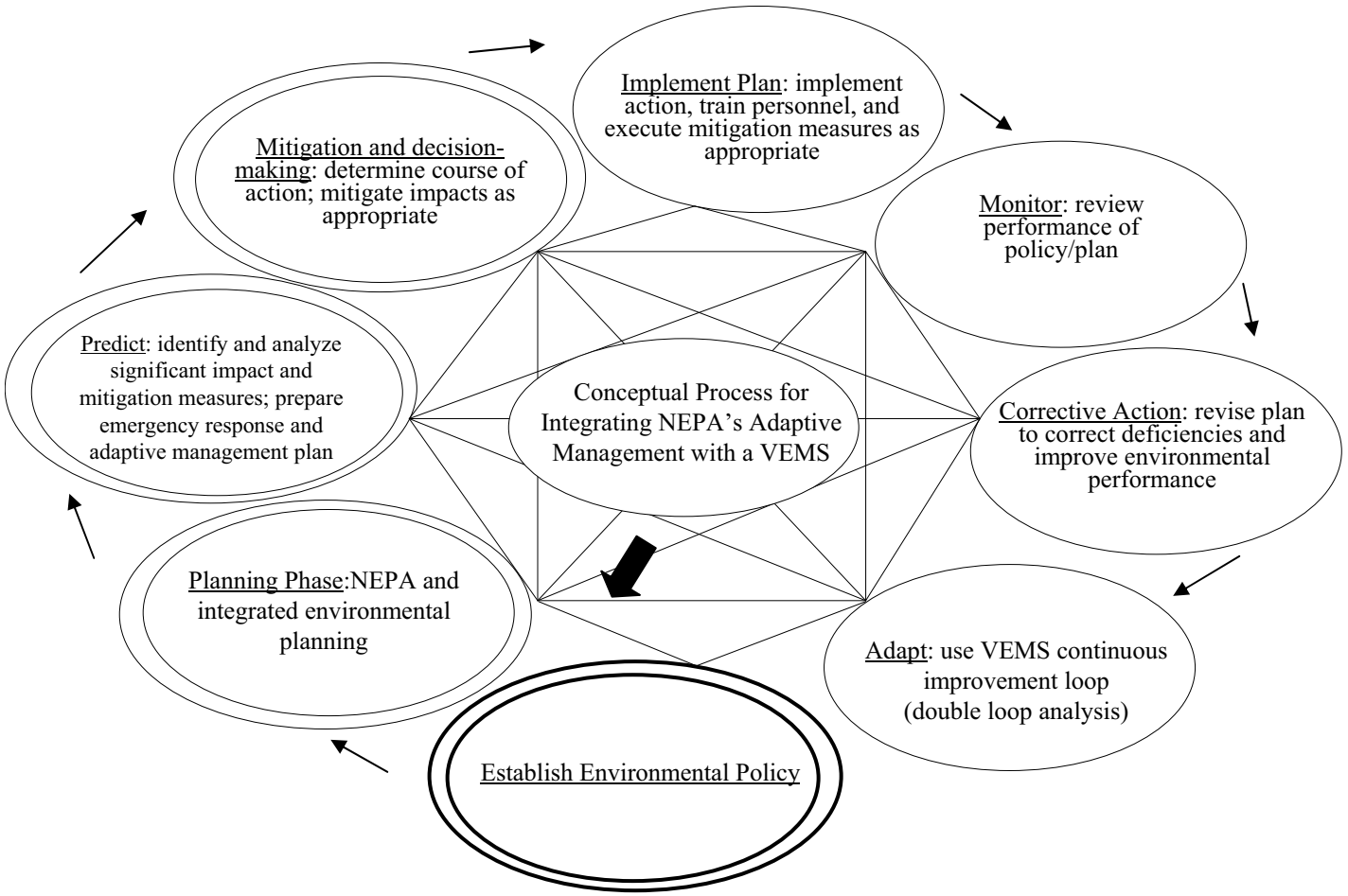

Figure 9. Conceptual process for integrating the U.S. National Environmental Policy Act (NEPA's) adaptive management with a VEMS. Adapted and modified from Eccleston, (2003 p. 65); see also Boling, (2005). The processes noted in the double-bounded ovals are typically performed under an adaptive management/NEPA concept whereas the others are accomplished under a voluntary environmental management system (VEMS). There is considerable overlap between NEPA's intent and voluntary environmental management systems standards. The reader should note that "integration" of provisions found in NEPA, EIA and VEMS is an on-going process; compare with Figure 10 from Eccleston and Smythe (2002 p. 10).

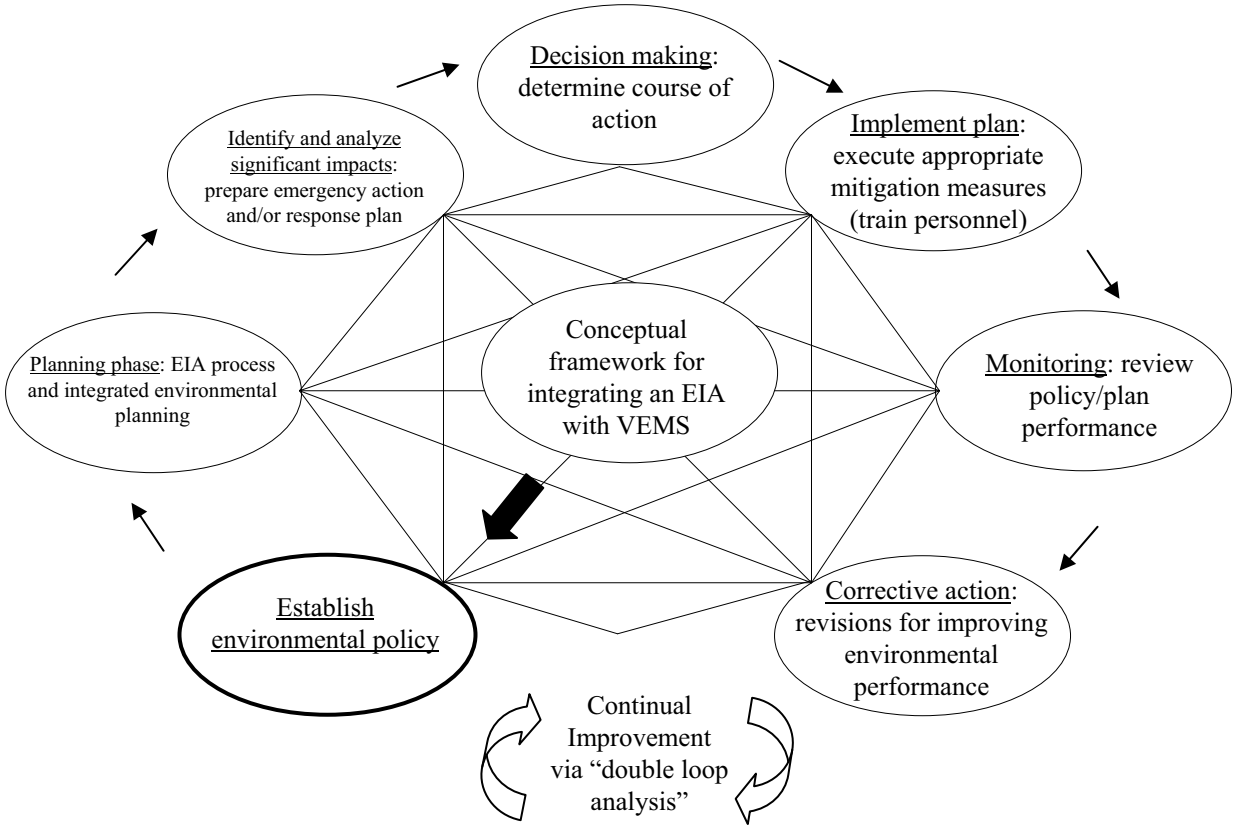

Figure 10. A conceptual framework for integrating an environmental impact assessment (EIA) with a voluntary environmental management system (VEMS). Adapted and modified from Eccleston and Smythe (2002 p. 10).

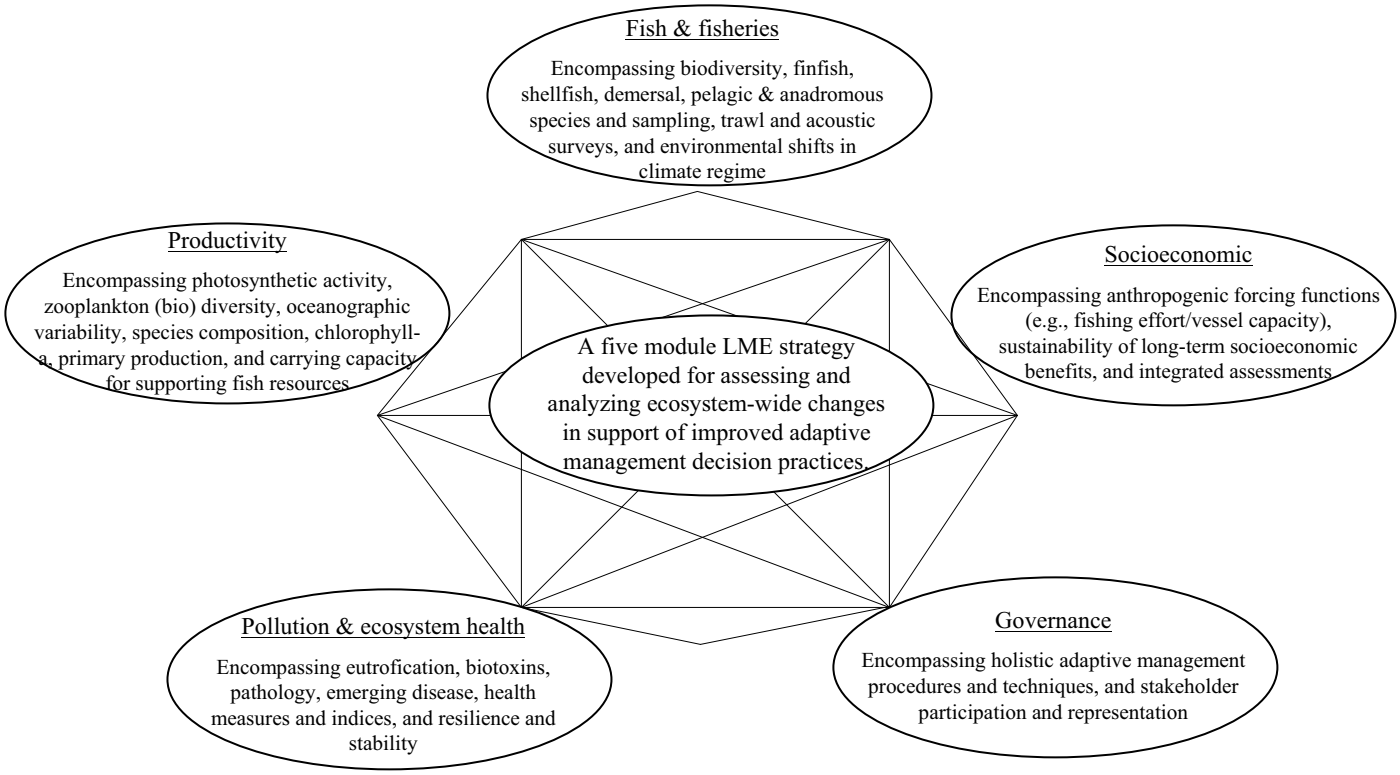

Figure 11. A five module LME strategy developed for assessing and analyzing ecosystem-wide changes in support of improved adaptive management decision practices (adapted from Sherman, 1994; Sherman and Duda, 1999b; see also Gable, 2005).

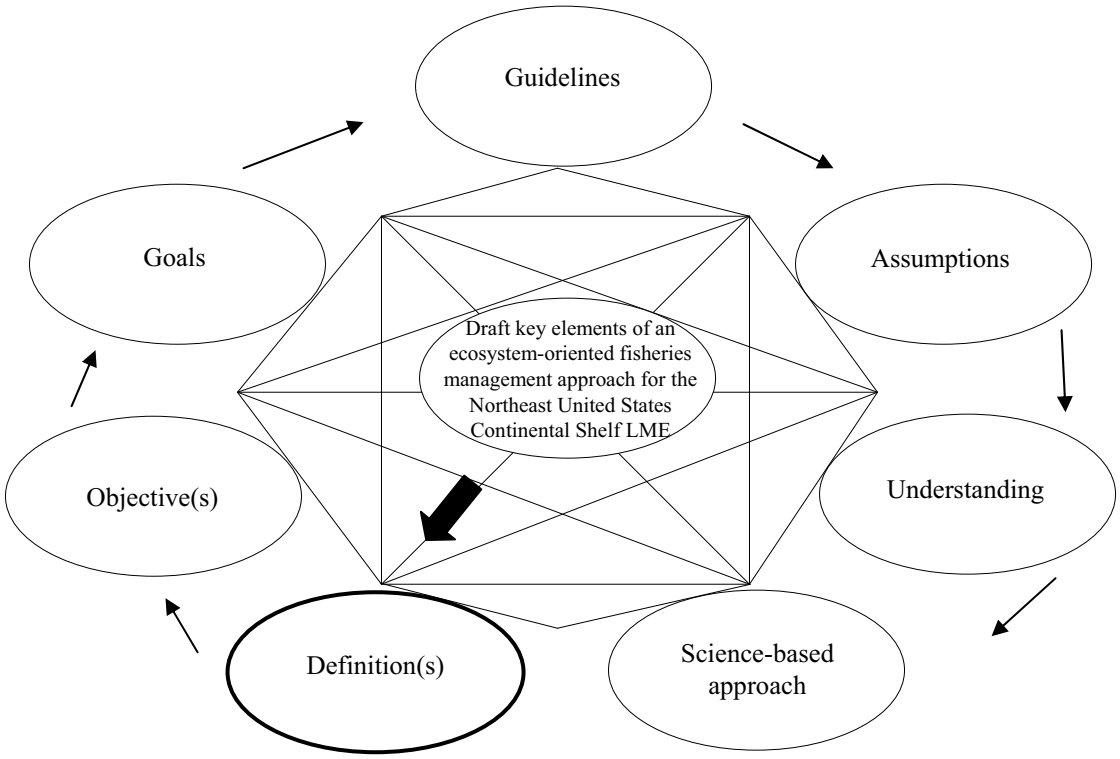

Figure 12. Draft key elements of an ecosystem-oriented fisheries management approach for the Northeast United States Continental Shelf Large Marine Ecosystem (LME) as a representative example, see Gable (2004 pp. 54 and 55 and references cited therein) for elaboration at http://www.nefsc.noaa.gov/nefsc/publications/tm/tm184/. Online available November 23, 2004.

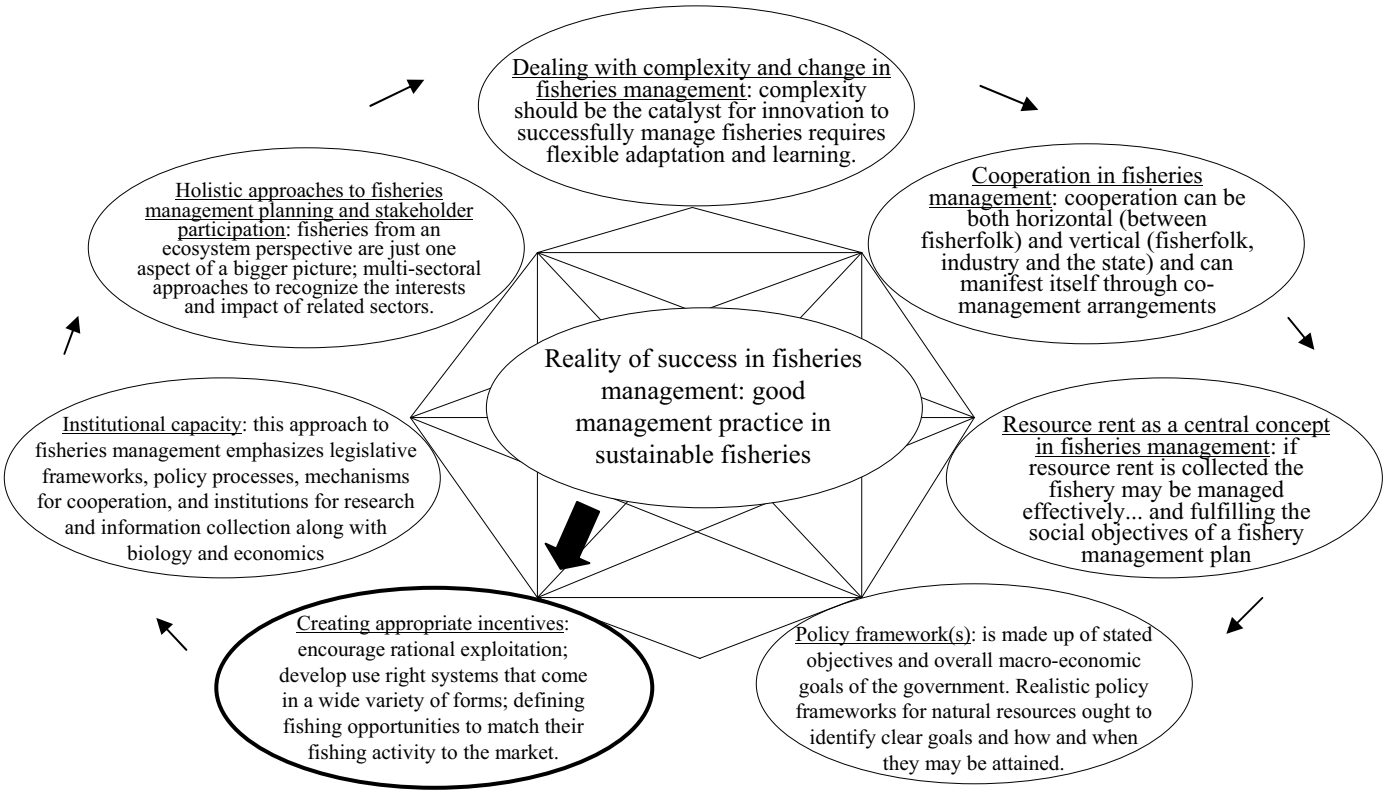

Figure 13. Good management practice in sustainable fisheries, according to The World Bank (2004), illustrates the importance of identifying the factors for success. Adapted and modified from the Support Unit for International Fisheries and Aquatic Research (SIFAR) of The World Bank, April 2004, Policy Brief No. 2. See also Di Leva (2004).

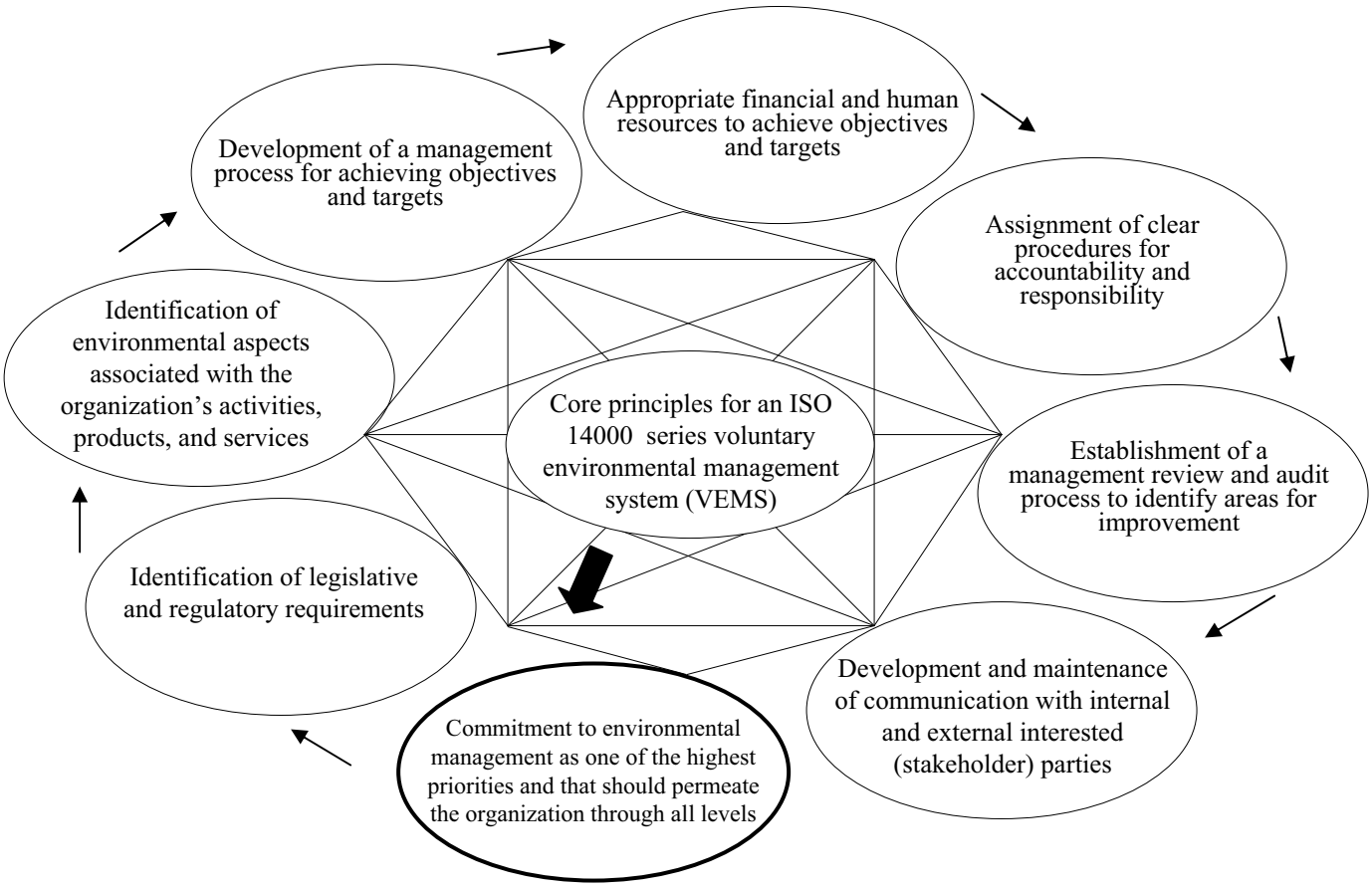

Figure 14. Core principles for an ISO 14000 series voluntary environmental management system (VEMS). "Environmental policy is defined as the 'statement by the organization of its intentions and principles in relation to its overall environmental performances which provides a framework for action and for the setting of its environmental objectives and targets'" (von Zharen, 1999, p. 12). For this manuscript, marine fisheries is the focus with a related "environmental policy" articulated to the National Standards listed and described in the Sustainable Fisheries Act of 1996 Public Law 104-297 (see Table 7). Themes expressed also pertain to international fisheries related "voluntary" and negotiated agreements and treaties.

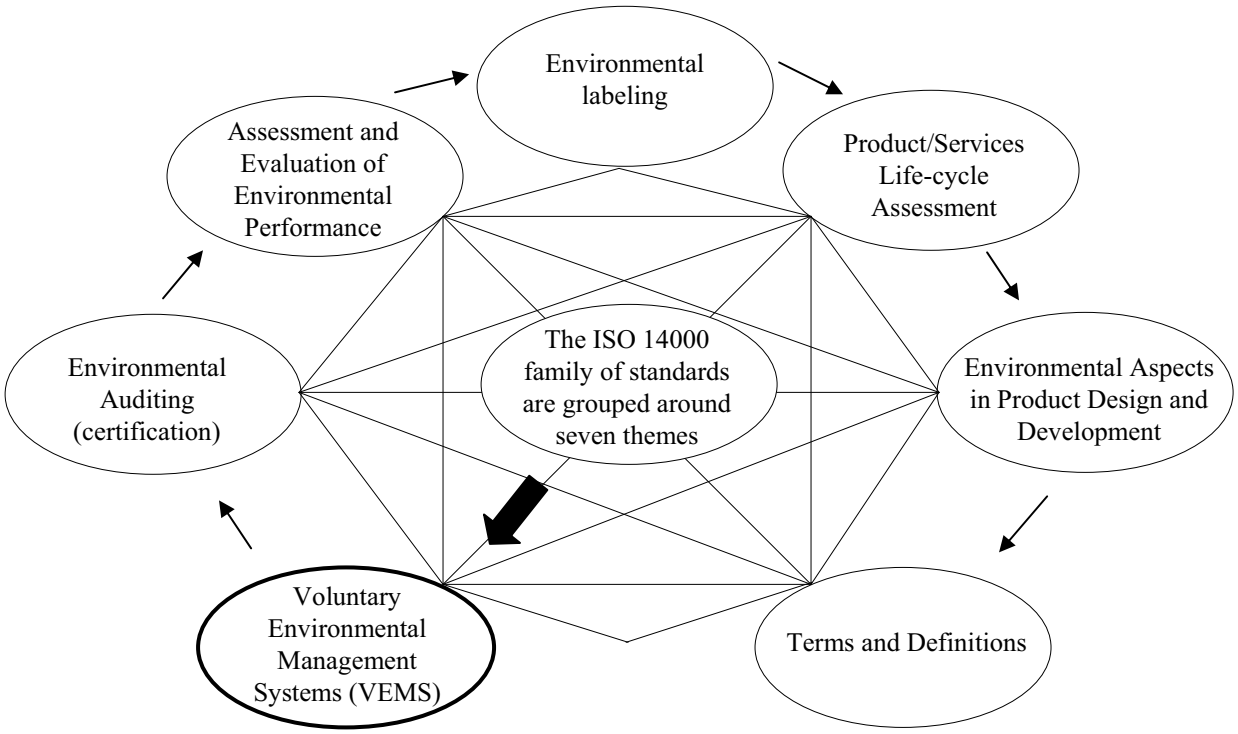

Figure 15. The ISO 14000 family of environmental-oriented standards are grouped around seven themes, adapted and modified from Berthelot et al., (2003, p. 48; see also Montabon et al., (2000 p. 5). The subject of this manuscript is centered on VEMS (ISO 14001 and 14004) as well as, to a lesser extent, eco-labeling (ISO 14020) in the marine fisheries sector.

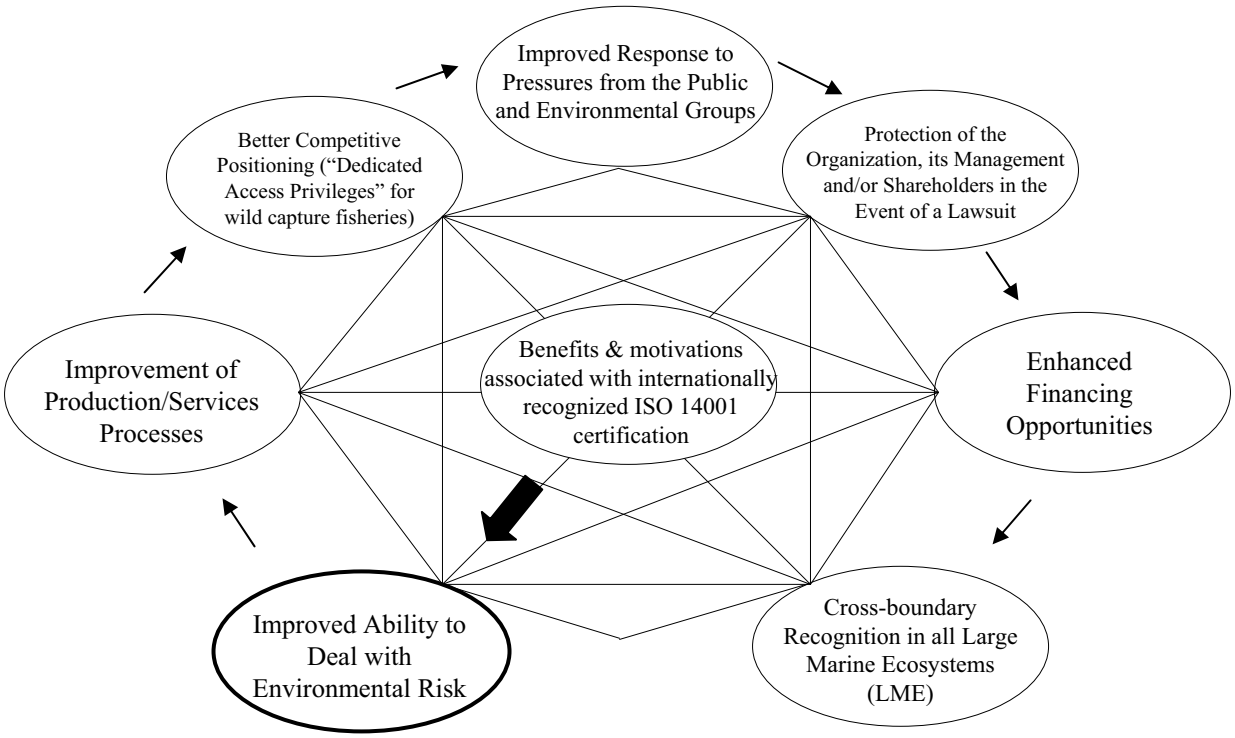

Figure 16. Benefits and motivations associated with internationally recognized ISO 14001 certification, adapted and modified from Berthelot et. al., (2003, p. 49). Regarding adaptive management and *environmental risk*, a prominent contemporary example is the situation of rebuilding year class 2003 stocks of haddock being inadvertently taken as bycatch in the directed herring fishery in the New England region (see: Steele, 2005 pp. 30-32 available at http://www.nefmc.org). The "risk" is closure of the herring fishery prior to the total allowable catch (TAC) being taken because of regulatory zero tolerance of groundfish (haddock) bycatch. This "zero tolerance" was modified by a recommendation of the New England Fishery Management Council (NEFMC) at their March (Newport, Rhode Island) scheduled meeting to request adaptive management "emergency action" of NOAA/NMFS. Emergency action regulations were promulgated by NOAA/NMFS allowing for the suspension of prohibition on possession of haddock with an incidental catch allowance of 1,000 lb. per vessel, per trip (see: *Federal Register* Vol. 70 (112) June 13, 2005 pp. 34055-34060). A bycatch cap of 270,000 lbs. on the total amount of observed and reported haddock of any size that could be landed under the haddock incidental possession allowance through December 10, 2005 was also enacted.

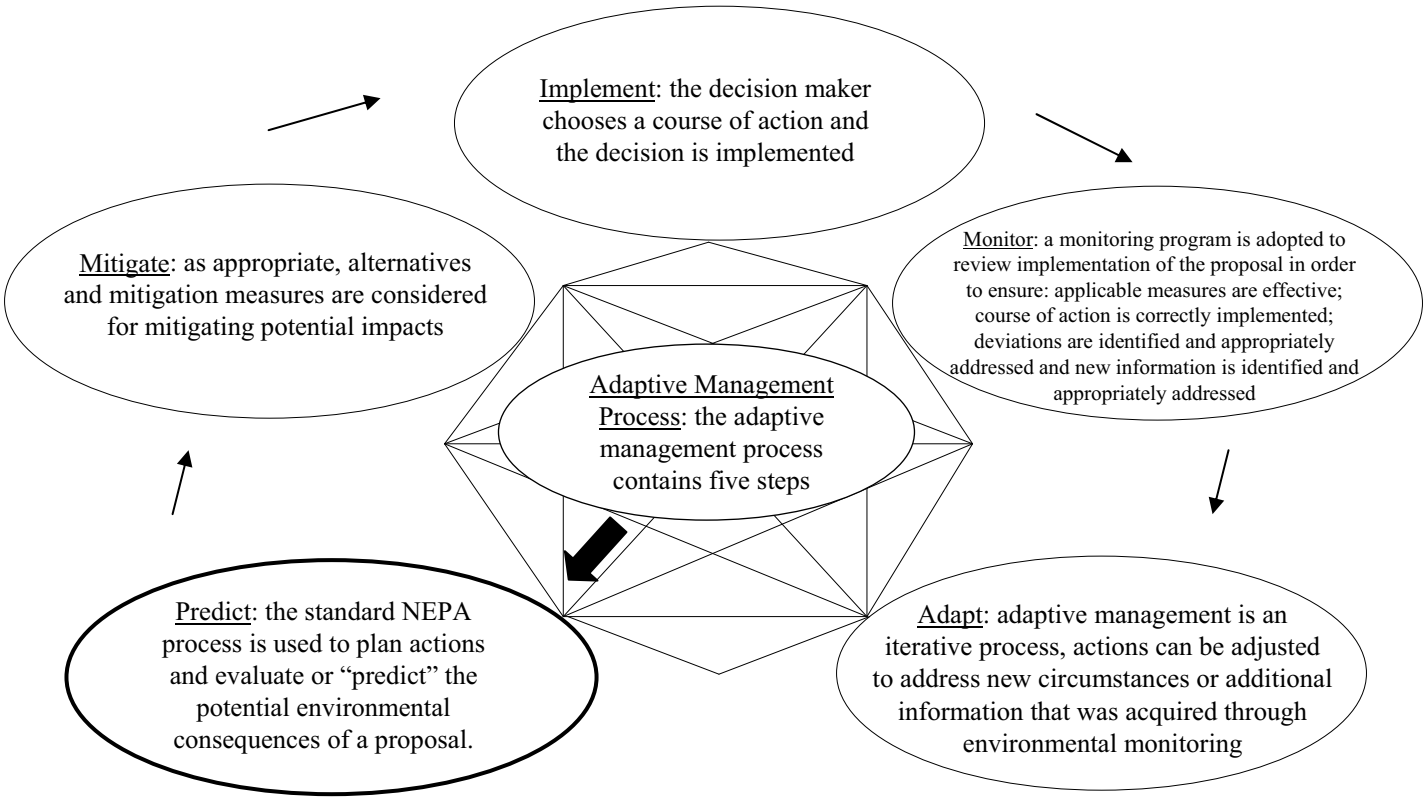

Figure 17. The adaptive management process according to Eccleston (2003 p. 60). "A model for adaptive management is found in ISO 14001" (von Zharen, 1998 p. 101).

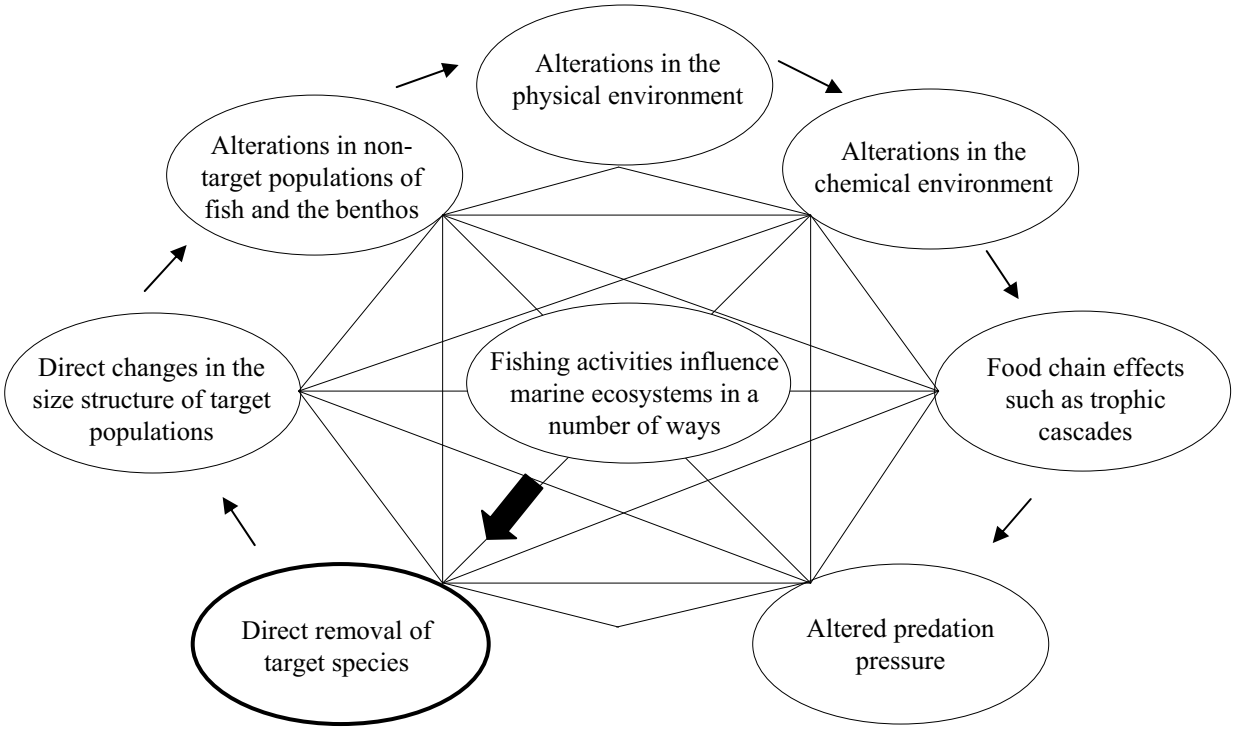

Figure 18. According to Frid et. al., (2005 p. 463) fishing activities influence marine ecosystems in a number of ways. The challenge of ecosystem-based fisheries management is taking a sustainable level of the targeted species while minimizing environmental and non-target populations alterations and food chain effects (Frid et al., 2005).

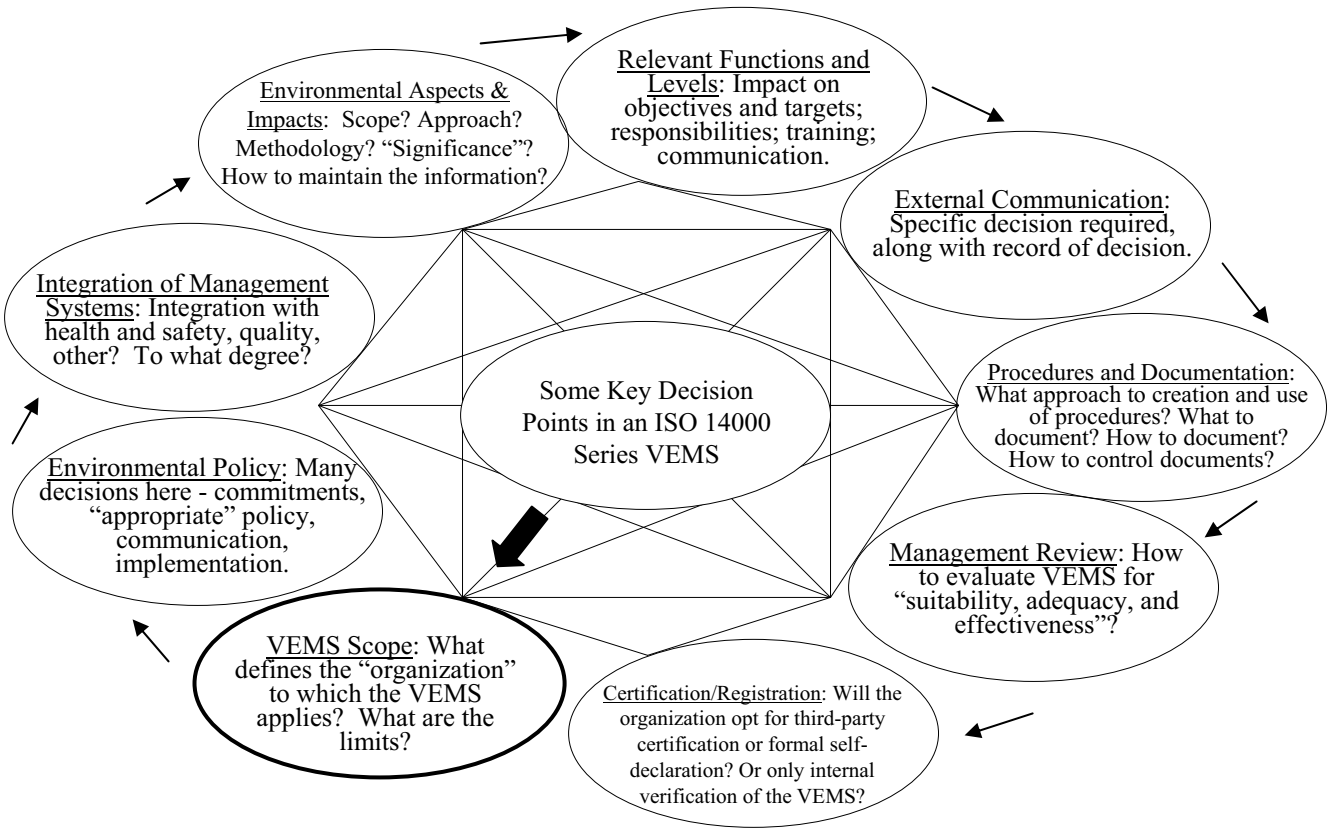

Figure 19. Some key decision points in an ISO 14000 series voluntary environmental management system (VEMS), adapted and modified from Ritzert (2000, p. 69). The intent is for the entity to seek continuous improvement (via double loop analysis).

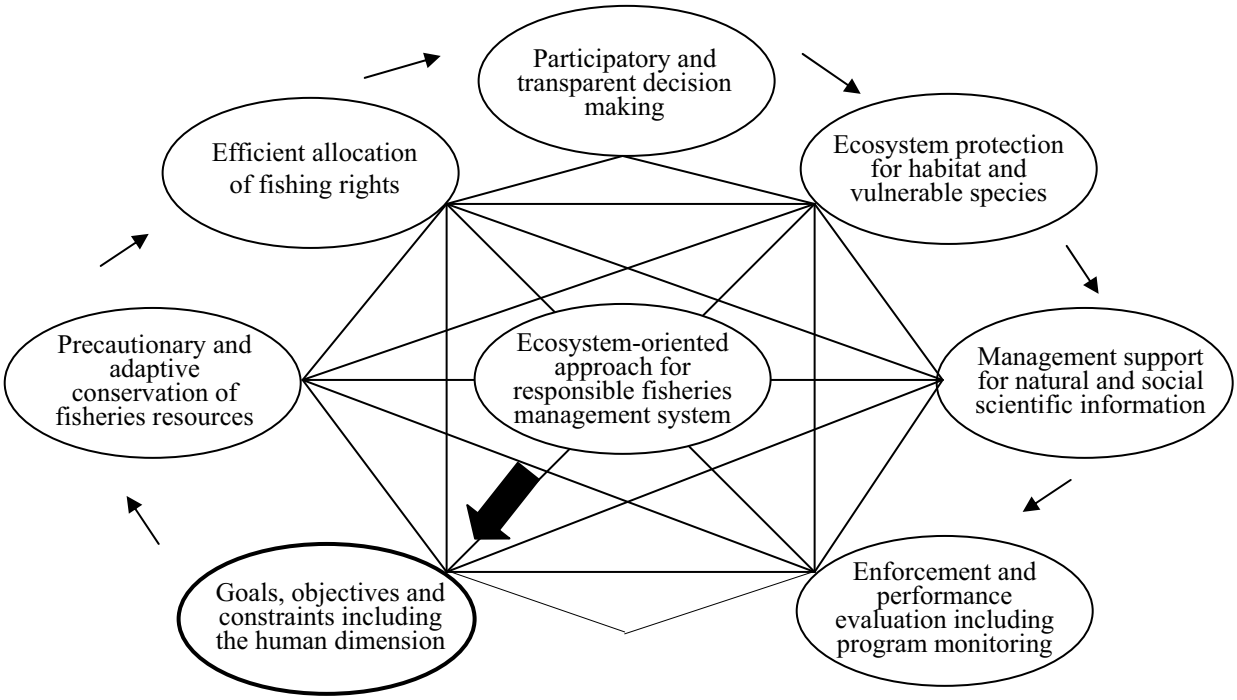

Figure 20. Based on scientific literature, and the stewardship experiences of Sissenwine and Mace (2003), an ecosystem approach to a responsible fisheries management system ought to encompass the listed parameters. An ecosystem approach also needs to take into account environmental variability upon fisheries resources. Six of the seven parameters of the fisheries ecosystem management system are also employed for single-species fisheries management (Sissenwine and Mace, 2003). It should not be a surprise, in the similarity between single-species fisheries management and ecosystem approaches.

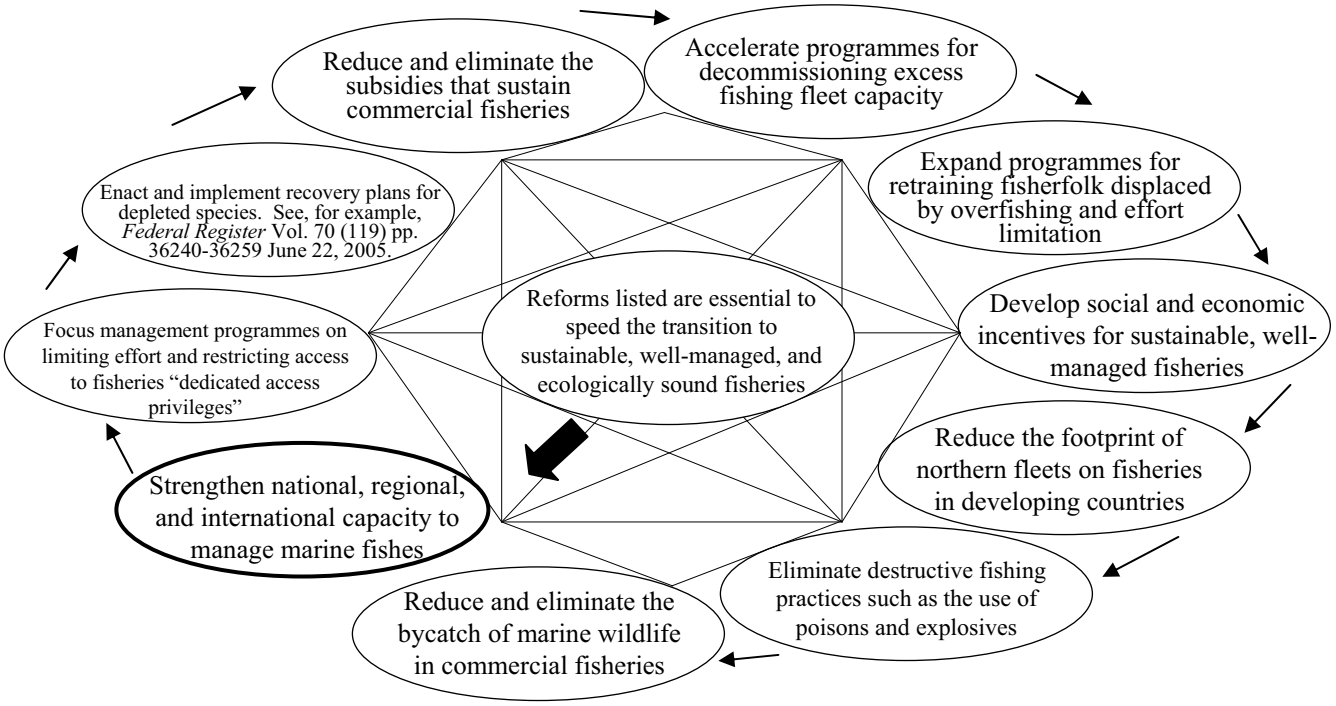

Figure 21. Reforms listed are essential to speed the transition to sustainable, well-managed, and ecologically sound fisheries according to Sutton (1998). They may be applicable in any large marine ecosystem (LME) setting.

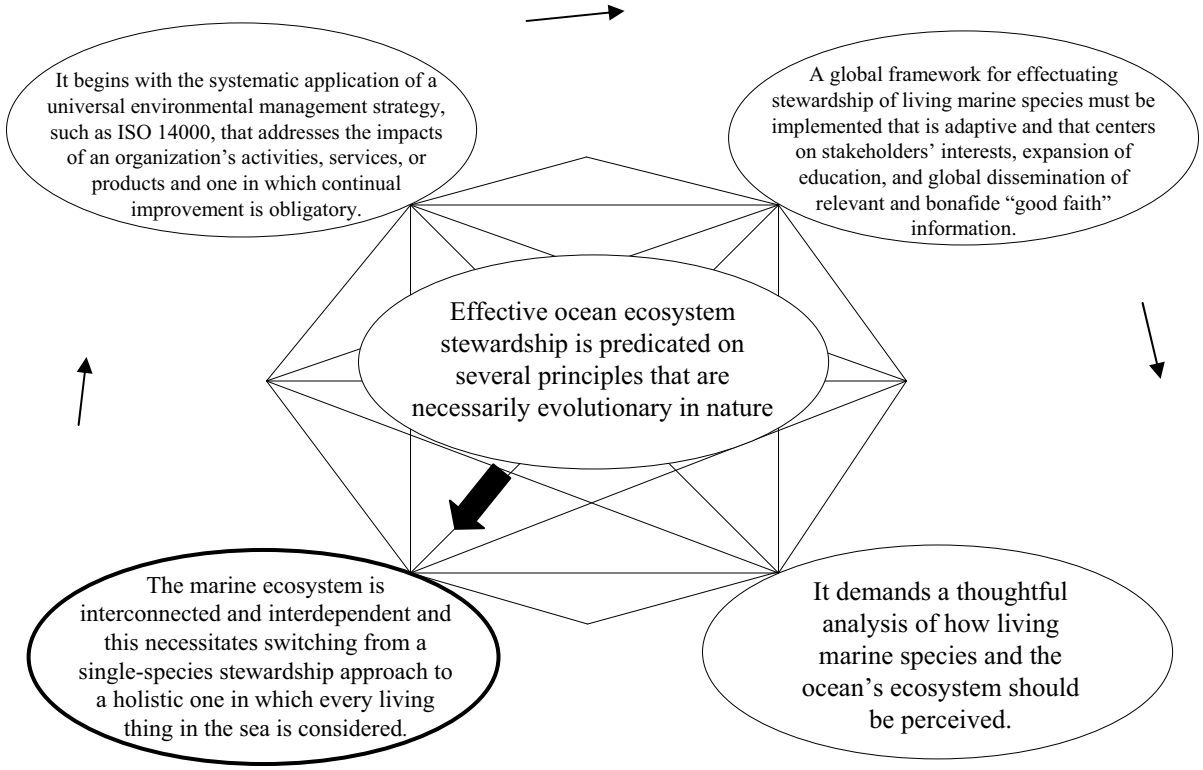

Figure 22. According to von Zharen (1998 pp. 107-108) effective ocean ecosystem stewardship is predicated on several principles that are necessarily evolutionary in nature and by design.

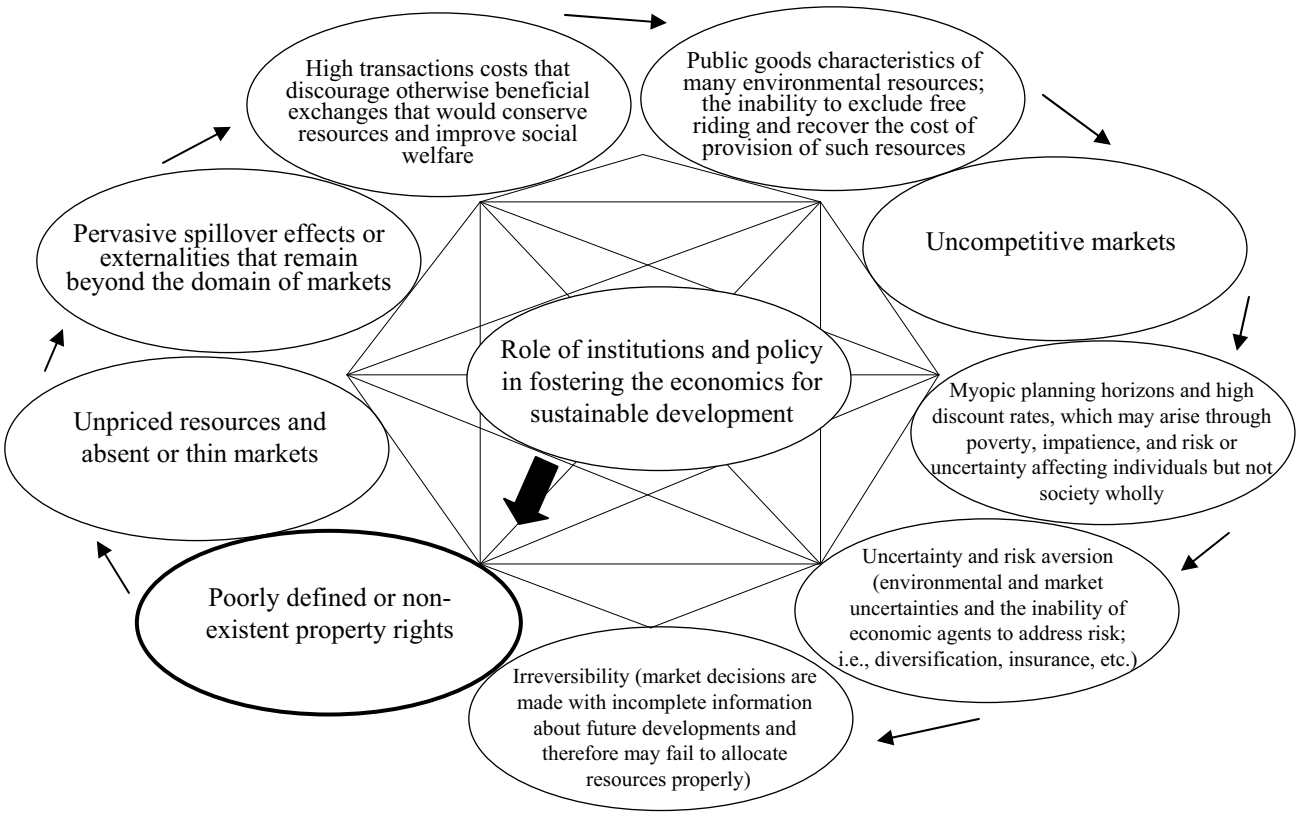

Figure 23. The role of institutions and policy in fostering the economics for sustainable development, market failures affect resource use and management, adapted and modified from Veeman and Politylo, (2003 p. 322 & 323). These authors argue that largely as a result of markets that fail to allocate resources efficiently among users over time leads to excessive depletion of natural resources and environmental degradation.

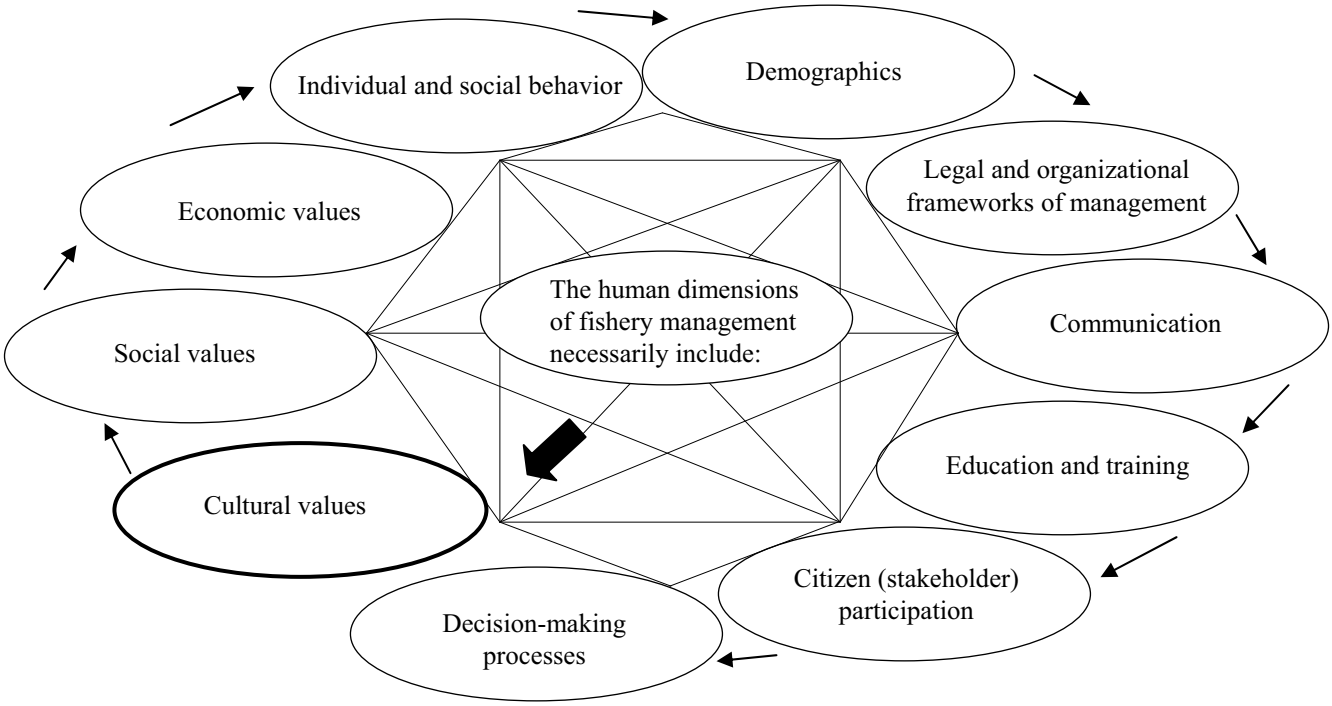

Figure 24. Dobson et al., (2005 p. 488) refer to "*human dimensions*" "as the study and practice of human values related to natural resources, how those values impact and are manifested in management, and how humans affect or are affected by natural resources management decisions" (see also: Hennessey and Sutinen, 2005). "Challenges of integrating ecological and human dimensions of management remain as important today as they were forty years ago" (Dobson et al., 2005 p. 487). "The human dimension is an important part of fishing and seafood industries" (Kaplan and McCay, 2004 p. 258). It is also of note that according to Daily et al., (2000 p. 396) "in a democratic society, values used in social decision-making ought to be derived from those held by its individual citizens and ought not be imposed by the state." The figure illustrates a new social science-oriented research theme that incorporate human dimensions of fisheries management in large marine ecosystems, adapted and modified from Dobson et al., (2005) and Hennessey and Sutinen, (2005).

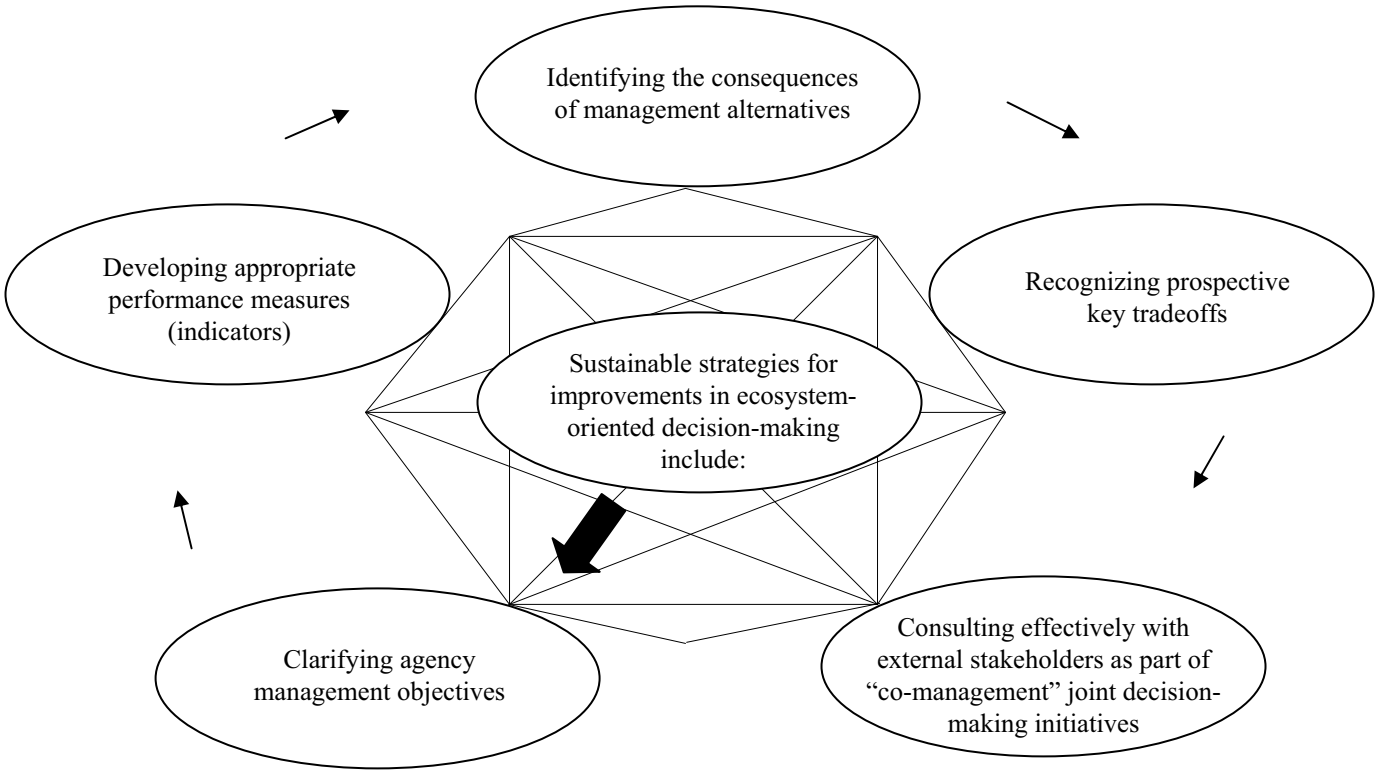

Figure 25. Included within the socio-economic module of the large marine ecosystem (LME) approach to fisheries management and sustainability are prospective improvements in decision-making that will aid managers to address a variety of related tasks, adapted and modified from Dobson et al., (2005 p. 489); see also Hennessey and Sutinen, (2005) and Hennessey, (2005).

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The mission of NOAA's National Marine Fisheries Service (NMFS) is "stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Science Center (NEFSC) supports the NMFS mission by "conducting ecosystem-based research and assessments of living marine resources, with a focus on the Northeast Shelf, to promote the recovery and long-term sustainability of these resources and to generate social and economic opportunities and benefits from their use." Results of NEFSC research are largely reported in primary scientific media (*e.g.*, anonymously-peer-reviewed scientific journals). However, to assist itself in providing data, information, and advice to its constituents, the NEFSC occasionally releases its results in its own media. Currently, there are three such media:

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