European Research Studies,
Volume XI, Issue (1-2) 2008

Marina Environmental Review System: A methodology to assess environmental management in recreational ports

By
Vassilis Stelios Tselentis*

Abstract:

This paper describes the basic requirements of an Environmental Management System for recreational ports (marinas), based on well-established systems such as ISO 14001, EMAS and the PERS methodology (Port Environmental Review System) recently developed by the ECOPORTS Foundation. A novel system that can assess the performance of environmental management has been created, appropriate to the marina environment, tailor made to the needs and requirements of each marina manager, aimed at supporting recreational ports to attain international accreditation (i.e. Blue Flag). This system, including environmental assessment and monitoring, was tested with major marinas in Greece and valuable conclusions were drawn.

1. Introduction

The last decade has seen a considerable increase in the extent and frequency of use of sailing and high speed craft, as part of recreational activities, as well as services provided to holiday makers, all around the world. It is however, necessary to point out, that the quality and offered services vary considerably from country to country (EOT 2003). The increase described above, has led to the creation of new marina developments, fully equipped with all modern amenities, offering upgraded services to users, especially in countries, as Greece, where tourism has become one of the most important economic activities.

It has been observed internationally, that in the tourist port sector, the tendency is towards the development of new marinas in areas with high tourist activity, usually of intermediate size (500-600 berths), as well as marinas in places where comparative advantage already exists (Kamarinakis A. 2000) These developments have also lured other activities to the coastline, creating the necessity of developing and introducing novel methodologies and practices in marina operation and maintenance, aiming at increased safety and the protection of the environment (Tselentis V.S., 2003). Special emphasis is given to the prevention of pollution that emanates from the activities in a marina, and although marinas around the world offer similar services, specific differences lie in the quality of services provided, differences arising from how environmentally

[1]*Associate Professor, Marine Sciences Laboratory Director, Department of Maritime Studies, University of Piraeus, 40, Karaoli & Dimitriou Str., Piraeus, 185 32, Greece. tel: 0030 210 414 2522, fax: 0030 210 414 2571, e-mail: tselenti@unipi.gr

friendly the marina activities are (Wooldridge C.F. 2001). Mooring services, storage, fuel and water supply, craft maintenance, engine maintenance and repair, disposal of litter and waste, are offered at all recreational ports around the world, however, those ports that have introduced environmentally friendly policies and have implemented regulations increasing safety and environmental protection, seem to be the ones that are finally preferred by the majority of boaters. A European framework for environmental management, which includes methodologies, practices and regulations, as well as highlighting the importance of further training of marina directors and users, is what, we believe, to be a necessity for the industry.

According to the European Sea Ports Organisation (ESPO) the fields most affected by marina activities and require management are, quality of water, quality of air, levels of dust and noise, loss of water and energy, waste and habitat loss (Wooldridge C.F. *et al* 1998). The activities of marinas are categorised into two main categories: a) activities related to the day to day operation of the marina, and b) those related to its further development (Wooldridge C.F.1997). All the above may increase pollution frequency concerning mainly in petroleum product and heavy metal residues, dust, odours, urban waste, garbage, as well as bring into notice aesthetic and cultural issues. A recent study examining the marinas in the region of Attica, showed that there was an increased awareness between managers, responding to a questionnaire, on the necessity of developing and implementing essential measures for the confrontation of accidental pollution incidents in their port area (Polychronidou G. *et al* 2000). It was pointed out however, that the legislative framework imposing environmental monitoring and reviewing conformity, although in place, i.e. water quality monitoring, which is undertaken by the State General Chemical Laboratory, needs special effort and tools for closer control and monitoring. In a corresponding study (Polyhronidou G. *et al*, 2000) concerning marinas in the region of New York, it was realised that all issues pertinent to environmental protection, rest within the householder and the director of marinas, with no directly relevant institutional and legal framework imposing conformity. Environmental repercussions set aside, recreational ports are very important for the local as well as the regional society. The locality, as well as planning and implementation of marina services are fundamental factors that should be taken into consideration when analysing the environmental implications of marina development and operation (Paipai E. 1999).

A Marina Environmental Review System (ERS) assists the marina to prepare a publicly available environment policy statement, set out strategies and methods for achieving these, regularly review the plans taking into account legislative changes, produce a publicly available Annual Environmental Review, consider the environmental monitoring required to assess environmental progress, establish a number of relevant environmental indicators with targets to measure progress and develop a platform for consultation and cooperation with the local community (Wooldridge C.F. *et al* 1999) .

The data presented here is based on interviews (via questionnaires) with managers of major recreational ports of Attica, and focuses on the basic environmental parameters, which constitute the basis on which marina

environmental management systems could develop in Greece. Proposals are offered as to the applicability of our findings on a European and international level. Based on selected environmental parameter measurements, performed within the framework of environmental monitoring programmes in recreational ports, undertaken by the Marine Sciences Laboratory, the importance of environmental monitoring, in terms of prioritizing environmental problems, as well as being a useful tool for evaluating the effectiveness of corrective measures taken, is also discussed.

2. Findings

The main sources of marine pollution are usually anthropogenic and include urban sewage, industrial waste and agricultural run off (Polychronidou G. 2000). High amounts of pollutants can lead to serious deterioration of marine waters as well as have a direct impact in the marine fauna and flora.

A usual environmental evaluation project consists of measurements of marine water renewal and recirculation times as well as sampling marine waters and sediments, for inorganic nutritious salts and heavy metals in marine water, and toxic heavy metals, organic carbon, hydrocarbons and organotins in sediments (Tselentis V.S. 2006), in order to estimate pollution load. As part of the environmental monitoring programmes undertaken by the Marine Sciences Laboratory of the Maritime Department, University Piraeus, *in situ* sampling and analysis of various environmental parameters are performed, following the methodology described in Fricker E. J *et al* 1997 and Tselentis B.S. *et al* 1999. Some results are presented in Tables I, II, III, IV and V, with the sole purpose of indicating that an Environmental Management System must be based on reliable and long term scientific data, in order to highlight environmental problems and also prioritize environmental issues that need attention

Table I: Physicochemical parameters of seawater in the marina

Sample	Date	Temperature ^{0}C	Conductivity mSi/cm^2	Salinity $^o/_{oo}$	pH	Turbidity NTU	TDS g/l
1	21/6/07	24.9	60,19	40,4	8,5	1	22,3
2	21/6/07	25,5	65,0	40,2	8,2	1.8	25,4
3	21/6/07	25,1	60,3	40,4	8,5	1,1	24,2
4	21/6/07	25,3	60,8	40,1	8,7	1	24,6
5	21/6/07	25,2	60,19	40,4	8,4	1,2	24,1
6	21/6/07	24,8	60,2	40,39	8,7	1	24,3
7	21/6/07	24,6	60,15	40,27	8,7	1,4	24,9

Table II: Microbial loads within the marina

Sample	Sampling date	Total coliforms/100 ml sea water	*E.coli*/100 ml sea water	Enterococci/100 ml sea water
1	21/6/07	6.893	1.122	23
2	21/6/07	1012	254	92
3	21/6/07	2.4234	512	35
4	21/6/07	435	43	12
5	21/6/07	310	21	9
6	21/6/07	477	29	18
7	21/6/07	322	24	10

Table III: Nutrient concentrations in surface waters of the marina

Sample	PO_4^{-3} (μmol/l)	NH_4^{+} (μmol/l)	NO_2^{-1} (μmol/l)	NO_3^{-2} (μmol/l)
1	0.29	1.33	0.15	15.1
2	0.38	1.7	0.33	8.4
3	0.22	1.22	0.21	6.6
4	0.36	1.04	0.09	4.4
5	0.32	0.87	0.10	3.3
6	0.25	0.95	0.15	3.5
7	0.33	1.11	0.20	3.1

Abbreviations : PO_4^{-3} phosphate ,NH_4^{+} ammonium, NO_2^{-1} nitrile, NO_3^{-2} nitrate

Table IV: Heavy metal and TBT♣ concentrations in surface sediments from the marina

Sample	Cr ppm*	Cd ppm	Cu ppm	Fe ppm	Ni ppm	Pb ppm	Zn ppm	TBT♣ ppb#
1	47.3	1.8	222	22,654	71	68	301	300
2	62.1	2.7	621	30,843	77	165	602	252
3	29.8	2.2	204	25,435	79	62	301	401
4	62.5	2.6	199	13,555	87	99	332	233
5	33.2	0.7	278	19,676	81	122	399	256
6	47.6	2.1	51	33,401	72	29	150	201
7	36.6	4.2	201	18,567	82	105	288	-

♣ Tributyl tin

*parts per million (mg/l)

#parts per billion (μg/l)

Abbreviations : Cr chromium, Cd cadmium, Cu copper, Fe iron, Ni nickel, Pb lead, Zn zinc

Table V. Long term monitoring of enterrococci contamination of sea water. Color coding highlights trends (MPN : most probable number of enterrococci in 100 ml of sea water)

MIKROBIAL LOAD RESULTS (2000 - 2004)

Enterrococci

Site Number	2000	2001	2002	2003	2004	2005	Key:
1	10111	2987	5099	1421	4569	1334	
2	1187	3282	2905	10111	10111	3609	Increase in MPN
3	10111	6893	203	97	226	984	
4	80	388	249	10	148	181	Same MPN
5	109	350	988	246	558	145	
6	354	305		109	288	108	Decrease in MPN
7	85	74	1515	281	359	31	
8	259	86	309	195	158	120	
9	213	10	3130	<1		<1	
10	20	<1		10		30	
11	31	62	933	20		10	
12	20	<1	717	<1		20	
13	20	<1	313	<1	109	20	
14	<1	<1		<1	10	30	
15	195	10		30	85		
16	275	132		41	231	31	
17	1259	556		41	413	63	
18	556	2282	10111	379	6586	8297	
19	695	413	529	109		305	
20	474	2063	187	179	1201	1187	
21	10111	2310	20	650		345	
22	10111	9606	10111	10111	10111	10111	
23	10111	10111	10111			2035	
24	10111	3609	10111	10111	2310	10111	
25				<1	160		
26				6910	327		
27				1674	547		
35			450				
36			959		10		
37		529	1106	148	52	41	
38	20	10	52	<1	86	20	
39	259	20	278	10	10	20	
40	<1	30	109	<1	<1	<1	
41	<1	31	20	<1	10	20	
42	20	41	86	52	20	<1	
43	10	10	10	<1	<1	<1	
44	<1	<1	41	<1	10	<1	
45	<1	218	2187	<1		41	
46	2282	288	2631	<1		97	

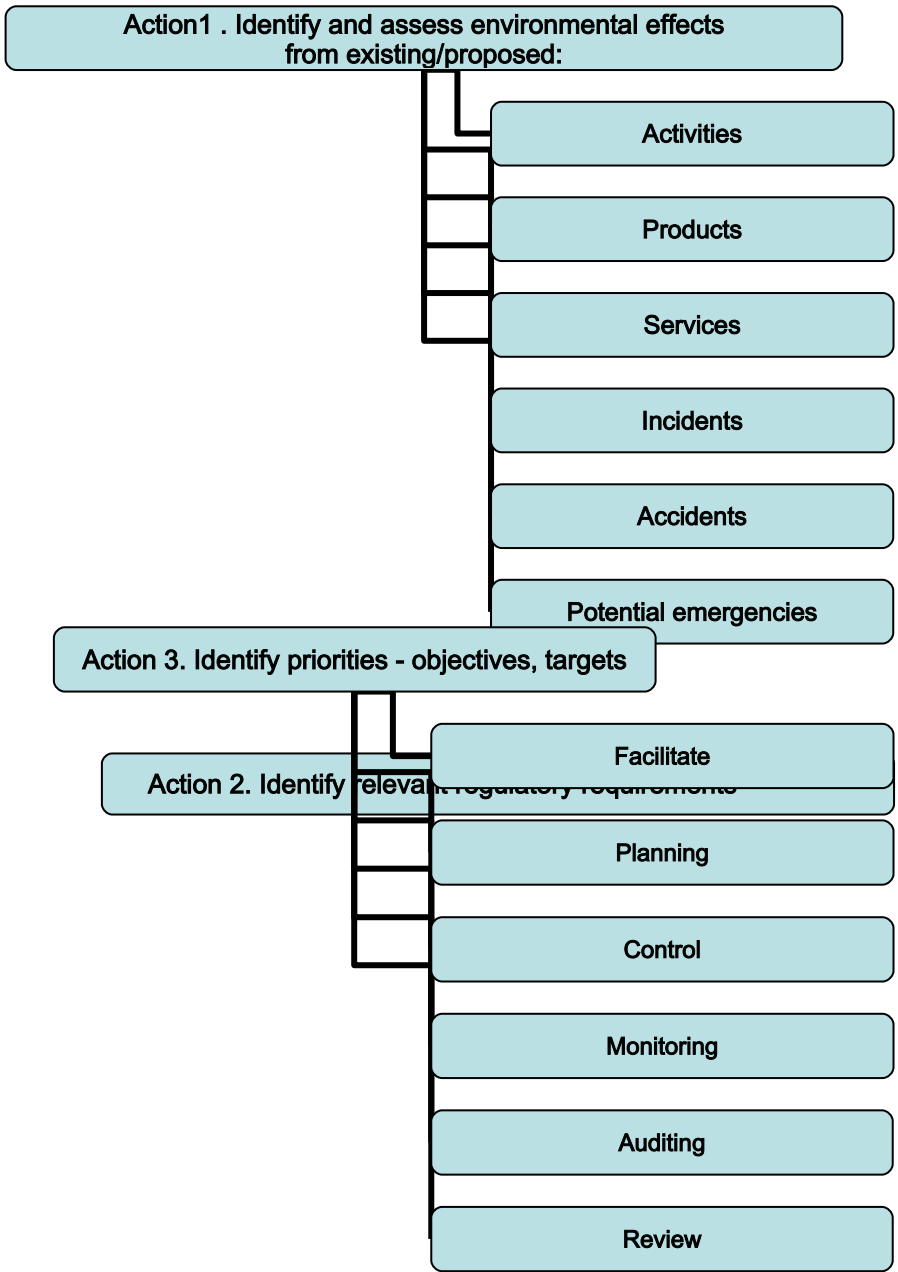
3. Environmental Management Model

It is obvious that despite the reliable scientific elements that can be collected in an appropriate environmental study, attempts at confronting the environmental repercussions created by marina activities, can only be successful if appropriate management options are considered and implemented (Wooldridge C.F. 2004). The adoption of such a functional organization of the port's activities aimed specifically at the goals of sustainable development and environmental protection

comprises of procedures that enable the port organization to establish and implement an environmental policy, attain objectives, and to demonstrate to the 'outside world' compliance with legislation. The systems being developed and used today are mainly based on codes such as ISO 14001, EMAS and the ESPO code of practice. Diagram 1 describes the preliminary actions and skills necessary for the adoption of an Environmental Management System (EMS).

Implementing such a system that can face up to the environmental challenges, has been proved to yield important profits for the marinas, such as considerably lower functional costs, better working conditions for the workers and increased satisfaction on the part of the customers. In Europe and in the worldwidwe commercial harbors network such systems constitute an integral part of the harbors management and business plan. Even if most marina directors consider that the activities in their ports have very little effect in the environment, it is very important to adopt an Environmental Management System (E.M.S.) regardless of the size and the type of activities.

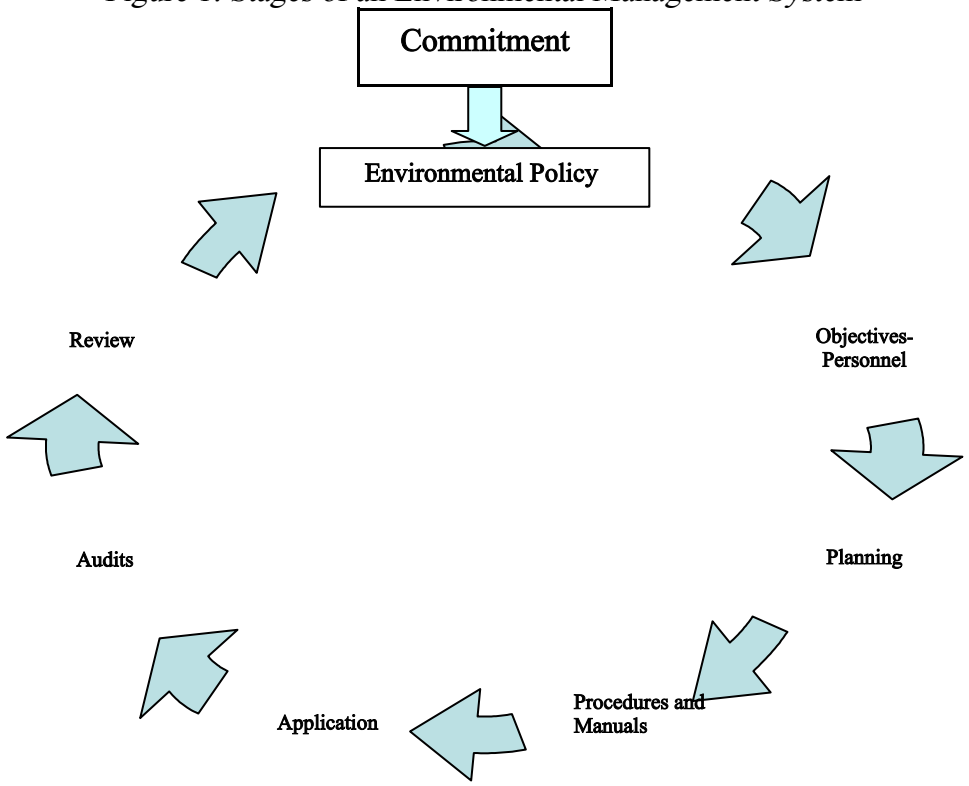
Diagram 1. Preliminary actions and steps leading to the adoption of an Environmental Management System.



Action 4. Be capable of evolution and adaptation to changing circumstances

The elements of an E.M.S, which can be modified depending on the needs and the possibilities of each marina, appears in Figure 1.

Figure 1: Stages of an Environmental Management System



The questionnaire distributed to the major Greek marinas (n=20), yielded the data presented in Table VI.

Table VI

Environmental Management System Component	2004 %	2007 %	% change
• Does the Marina have an environmental plan?	13	14	+1
• Does the plan aim for 'compliance-plus'?	4	4	-
• Does the plan aim to raise environmental awareness?	54	58	+4
• Is environmental monitoring carried out in the port?	25	37	+12
• Does the plan involve community & stakeholders?	3	5	+2
• Is the ESPO Code of Practice available in the port?	10	25	+15
• Does the marina have designated personnel?	44	65	+21

4. Conclusions

Marinas constitute sources of pollution for coastal waters. Consequently, the assessment of environmental repercussions from their activities must be a prerequisite as well as be incorporated into the framework of planning and decision-making of these recreation ports, in both the development/construction as well as the operational stages. In most countries, the requirement for an Environmental Impact Assessment Study is obligatory by the legislative and administrative regulations, while in other countries such assessments are incorporated in the planning and permit issue stages. In Greece the Environmental Management Plan (as described in EU Directive 2000/59) is an integral part of the Special Operation Regulations for tourist ports. Over and above these regulations, vessels not equipped with sewage collection tanks or biological treatment systems will not be admitted to a recreational port. Taking into consideration the legislative provisions and the directives of EU concerning the port-marina sector, it is obvious that the application of an Environmental Management System (EMS) is eminent. The situation in Greece (see Table VI) is encouraging, at the moment, since more and more directors are prepared to introduce such systems. The fact that over the last three years, a positive change towards managing environmental impacts and achieving sustainable development and environmental protection is revealed, must be seen as an encouraging development. Even though slight change has occurred in issues such as aiming at "compliance plus" environmental protection and the involvement of stakeholders, other topics are gaining increased momentum. Environmental monitoring is becoming a priority issue for marinas, as more managers are increasingly under pressure to identify performance

indicators which confirm compliance with environmental legislation, demonstrate continual improvement of environmental quality, and measure the effectiveness of the management system itself. At the same time they also realize the benefits of applying quality assurance principles and techniques aimed particularly at attaining high grades of safety and environmental standards, since such an approach is rapidly becoming an increasingly significant component of the business plan and policy document of may major companies and organizations.

References

1) EOT General Tourist Port Operation Regulations. No T/9803 (Official Gazette Issue No 1323, September. 16, 2003), Athens 2003.
2) European Directive 2000/59 of November 2000, as adopted to the Greek legal framework with the Joint Ministerial Decision No 3418/07/2002 (Official Gazette Issue No 712/8).
3) Fricker E. J., Illingworth K. S. and. Fricker C. R., 1997, "Use of two formulations of Colilert and QuantiTray ™ for assessment of the bacteriological quality of water", Water Research, Volume 31, Issue 10, 2495-2499.
4) Kamarinakis A., 2000, "New legislative frame - processes for the operation of tourist ports (marinas)", Proceedings of Greek Coasts and Seas in 2000, p.p. 57-66.
5) Lagos D., Curtis G. P., 2004, "An Integrated Total Quality Strategy To Endogenous Tourism Development", European Research Studies Journal, Vol. VII, Issue (3-4) pp. 17-28.
6) Paipai E., 1999 "Guidelines for port environmental management", HR Wallingford Ltd, Report Sr55.
7) Polychronidou G., 2000, "Management of environmental issues in marinas", MSc dissertation, Cardiff University, Department of Maritime Studies and International Transport.
8) Polyhronidou G., Tselentis V.S.and Wooldridge C.F., 2000, "Environmental effects from the operation of marinas-preliminary studies of application of an Environmental Management System". 2nd Pan-Hellenic Congress of Harbour Works, 20-23 November, NTUA., Athens.
9) Tselentis B.S., Maroulakou M., Lascourreges J.F., Szpunar I., Smith V., and Donard O.F.X., 1999, "Organotins in Sediments and Biological Tissues from Greek Coastal Areas: Preliminary Results", Marine Pollution Bulletin, 38 (2), 146-152.
10) Tselentis V.S., 2003, "Environmental management of harbour activities", *Naval* Chronicles, 59, 4-003, 76-77, (in Greek).
11) Tselentis V.S., 2006, "Technical Report to the Piraeus Port Authority - Cumulative Results of the Environmental Monitoring Programme 1996 – 2006", (in Greek).
12) Wooldridge C.F., 1997, "Environmental auditing of port and harbour operations", The Dock and Harbour Authority, December/January, pp.180-183.

13) Wooldridge C.F., 2001, "Quality Assurance in port operations", BIMCO Bulletin, Vol. 95, No1, pp.56-59.
14) Wooldridge C.F., 2004, "Environmental Management - progress through partnership", Marine and Ports Review, 25-31.
15) Wooldridge, C.F., Mc Mullen, C. and Howe V., 1999, "Environmental management of ports and harbours - implementation of policy through scientific monitoring", Marine Policy, Vol. 23. No4, 413-425.
16) Wooldridge C.F., Tselentis B.S. and Whitehead D., 1998, "Environmental management of port operations – The ports sector response to the European dimension". Maritime Engineering and Ports pp. 227-242. G. Sciutto and C.A. Brebbia eds, WIT Press.