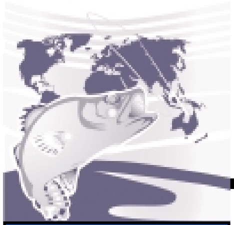

THE COMPLEAT ANGLER AND THE MANAGEMENT OF AQUATIC ECOSYSTEMS

Tony J. Pitcher

Fisheries Centre, University of British Columbia, Vancouver, British Columbia, Canada

Abstract

In a crowded world, those who fish for fun will be compleat only if they do not harm aquatic ecosystems and if they fish in harmony with other resource users. This paper present elements that can be used towards building a comprehensive ethical framework for recreational fishing. The ethics of fisheries have been analyzed into five components: ecosystem, distributive, productive, restorative and creative justice. For sport fisheries, these ethical components are discussed in relation to sustainability and the rebuilding of depleted and damaged aquatic ecosystems.

Evaluation of the benefits of sport fisheries has generally been rooted in an economic modality, yet ethical considerations must go beyond cash values. Caring about ethics is pragmatic: fair allocation decisions are more likely when the trade-off between economic benefits and ecological impacts is transparent. On an individual cognitive level, ethical behaviour helps to maximize the dream-per-fish ratio in humans, a desired product of angling recognised since Isaak Walton subtitled his book “The Contemplative Man’s Recreation”.

The Food and Agriculture Organisation (FAO) Code of Conduct for Responsible Fishing provides internationally agreed and comprehensive ethical guidelines against which all fisheries may be judged: the paper suggests that over 90% of the items in most of the twelve articles of the FAO Code apply to recreational fishing.

Responsible fisheries should aim to provide accurate information about their ecological impacts: examples are presented from sport fishery catches in Canada and Kenya. Moreover, responsible fisheries should be able to know what their economic and social benefits are: examples of how this may be achieved are presented from a newly published book on this topic (Recreational Fisheries: ecological, economic and social evaluation, Pitcher and Hollingworth, 2002).

A novel quantitative technique for evaluating the status of sport fisheries is introduced. Based on a multi-disciplinary rapid appraisal method called ‘Rapfish’, the paper presents some preliminary case studies. ‘Rapfish’ for recreational fisheries contains separate evaluation fields for ecological status, economic value (current and potential), social impacts, management performance and fishing experience. Each field contains five to nine attributes that can be scored rapidly in a preliminary fashion and refined later. ‘Rapfish’ uses a non-metric ordination, multi-dimensional scaling, to derive ratings for each fishery in each evaluation field. Uncertainty may be accounted for using Monte Carlo simulations, and the influence of individual attributes can be described quantitatively. ‘Add-in’ routines for the Excel spreadsheet software are available. Overall results may be presented as a multi-axis kite diagram for comparison with other fisheries, with historical analyses, or with the forecast impact of new policies. An explicit ethical field may be added to the ‘Rapfish’ evaluation if desired.

The paper suggests how an ethical framework will help anglers become compleat through being perceived as taking a full and responsible role in the management of aquatic ecosystems.

Introduction

An archaic spelling of ‘complete’, ‘compleat’ is defined (OED, 1999), as ‘quintessential’ and has connotations of calm and self-sufficiency. Piscator, the hero of Isaak Walton’s elegiac book (Walton and Cotton, 1676) is the essence of such gentle sensibility. Watching us from the 1650s, Walton’s Piscator would doubtless be horrified and alarmed at the scale of depletion in today’s aquatic ecosystems (Christensen et al., 2001; Pauly, 1998). Those who have brought about the overexploitation of the world’s aquatic ecosystems are, after a long period of ignorance and indifference, in the process of being brought to account in a dramatic fashion by public opinion (Pitcher, 2001). This paper looks at the role that compleat anglers may play while continuing their sport in today’s threatened ocean. The principal message is to find ways to evaluate progress in achieving responsible and ethical sport fisheries (Pitcher, 1999a), and to be seen to be doing so by the public. Sport fishers must aid the rebuilding of depleted and damaged ecosystems (Pitcher, 2000).

The ethics of fisheries have been analyzed into five components: ecosystem, distributive, productive, restorative and creative justice (Coward et al., 2000). For sport fisheries, these ethical components are vital for sustainability, equity and the public perception of progress. Ethical analyses may be quantitative (Pitcher and Power, 2000), and application to sport fisheries would be pragmatic, encouraging public perception of anglers as protectors, rather than despoilers of wilderness. Ethical behaviour is clearly a key to this, since the opposite brings fishers and their managers into disrepute (see Sullivan, 1999). Nevertheless, some issues, such as catch-and-release lead to an ethical dilemma. In North America catch-and-release has been adopted to aid fish populations (Policansky, 2002) and the principal issue is survival subsequent to handling and release. In Europe the perspective is more equivocal, and some countries, e.g. Germany (Steffans and Winkel, 2002) forbids catch-and-release, an attitude perhaps encouraged by an active anti-hunting lobby. Aboriginal North American tradition supports this view, young persons being taught by elders "not to play with your food" (Jones and Williams-Davidson, 2002).

The Food and Agriculture Organisation (FAO) Code of Conduct for Responsible Fisheries (FAO, 1995; Doulman, 1998) was developed during the early 1990s in response to the beginnings of serious concerns about the impact of fisheries. Its text was agreed amongst all UN governments in 1995, and, to date, over 20 countries have ratified. Of the 12 Articles of the Code, six cover general principles, one aquaculture and one, post harvest practices. The remaining four Articles are highly relevant to sport fisheries: fisheries management, fishing operations, fisheries research and integrated coastal area management. I examined the 53 clauses and sub-clauses of Article 7 'Fishery Management'. The material partitions into 110 discrete fisheries issues discussed by the Code. Of these, I found 62% highly relevant and 24% relevant, making 96% in all, relevant to sport fisheries. Compliance with Article 7 of the Code may be evaluated using a six-field rapid appraisal technique (Pitcher, 1999b). FAO is mandated to help evaluate compliance (e.g. FAO, 1990). Since their governments have already supported its development, I suggest that public perception of responsible behaviour would be enhanced if sport fishers adapt the existing Code of Conduct, in consultation with FAO, rather than invent a new one.

The majority of existing evaluations of sport fisheries are concerned with economics (Rudd, 2002). Tracking total expenditure adds up the various market transactions involved in sport fisheries (payment of licence fees, boat and guide hire, sales of rods, travel and fuel costs, magazines). But, where it has been tried, this is surprisingly difficult. Some annual figures are: Germany, US$1 billion (Steffens and Winkel, 2002); England and Wales' freshwaters, US$3.4 billion (Lyons et al., 2002); Sweden, US$281 million (Toivenen, 2002); Denmark, US$60 million (Toivenen, 2002); one South African sport fishery, US$250 million (Griffiths and Lamberth, 2002). But large-scale surveys cost a lot (Lyle et al., 2002; Duffield et al., 2002; Gentner and Lowther, 2002) and "apart from plain money and work, a multinational survey takes more time than you think" (Toivenen, 2002).

Contingent valuation methods (CVM) generally produce lower values for sport fisheries than expenditure: in one Nordic survey willingness to pay (WTP) for fishers was about 42% of expenditure (Toivenen, 2002). But WTP methods are not robust in the face of changes in earning power – for example the amount you might pay this week may not be the same next week after you have lost your job (Pitcher and Hollingworth, 2002). WTP is also challenged by international currency exchange. For example, a US citizen big-game fishing in Kenya spends more money in one day than a local person might earn in 5 years, so these two actors have very different WTP responses.

A more robust methodology uses the 'method of paired comparisons', also termed a 'damage schedule' (Knetsch, 1994). Surveyed participants are asked to choose the more desirable of a pair of alternatives, but no direct monetary value questions are asked. By taking all possible pairs, the rank order and degree by which each option is preferred can be estimated (see Chuenpagee et al., 2001). Rudd et al. (2002) mentions an example where monetary values may be included in the choices. The technique deserves further exposure, especially perhaps when evaluating sport fisheries in developing countries.

Kearney (2002) draws up detailed balance sheets of costs and benefits for ecology, economics and social fields. In Kearney's ecological balance sheet, 8 from 15 (53%) issues have been tackled; from the economic balance sheet, only 3 from 10 (30%) are addressed; and from the social balance sheet, 5 from 18 (27%) issues receive some mention: overall, only one in three of the key issues have been tackled. It is alarming that so few of the key issues have been rigorously researched.

Is the fishery sustainable? Is it managed according to best practice? How well is management doing? What is the conflict status? What is the overall status ? None of the existing methods covers the full range of such questions and hence, in this paper, a novel multidisciplinary method for evaluating sport fisheries is presented. A rapid appraisal technique, Rapfish (Pitcher and Preikshot, 2000) is adapted for use in quantifying perceptions of status in five fields: ecological, economic and social status, management performance and fishing experience. The method is based on a multidimensional scaling ordination that is anchored by a number of fixed reference points, including the best and worst possible scores. The influence of individual attributes can be analysed by a step-wise procedure, and Monte Carlo simulations can be performed to address model uncertainty. 'Add-in' routines for the Excel spreadsheet software are available from the author.

For this paper, participants were asked in a questionnaire if they strongly agree, agree, are neutral, disagree or strongly disagree with a series of questions such as: “Fish caught in the sport fishery are of comparable size to what might be found in a pristine fishery”. Answers were assigned values on linear scale that were then normalised before the Rapfish computations.

Ecological evaluation of status included questions on the following attributes; assessment status of fish stock, habitat status, size/age limits, minimisation of by-catch, protection of spawners, exotics/introduced species and food web effects and mortality of target species.

Economic evaluation included; total profit, local economic benefit, expenditure category, cash value of local jobs, angler contribution to foreign exchange earnings and marketing.

Social evaluation included; breadth of social benefits, conflict status, social value of local ownership, social value of local jobs, co-management and security of tenure.

Evaluation of management performance included; aims of regulations, effectiveness of regulations, compliance with rules, equity of access, collection of data for management, habitat protection/restoration, communication of rules and management costs.

Evaluation of fishing experience included; size of fish, catch rate, perceived ecological impact, crowding, facilities, perceived value for money and regulations.

In a pilot trial, nine respondents scored 17 fisheries (Canada, nine; Kenya, four; South Africa, two; USA, one and Mexico, one) and the data was subjected to the Rapfish analysis. For all fields, the calculated leverage of individual attributes on the Rapfish status scores was less than 5%, showing that the multivariate analysis is well behaved. Monte Carlo simulation suggested that model error was around 10%.

The Rapfish ordination provides two values for each evaluation field: one a status score and the other a value that expresses distinguishing features among the fisheries. An example is given in Figure 1 (and it’s legend). Kite diagrams can express the multidisciplinary status of selected fisheries at a glance (see Figure 2 and it’s legend).

Anglers, especially older ones, tended to rate a fishery lower than managers, while boat owners rated a fishery higher than non-owners. Where the same fishery was scored (for example the Cape Town big-game fishery), perceptions differed by about 20% in all fields except angling experience, where it could reach 40%.

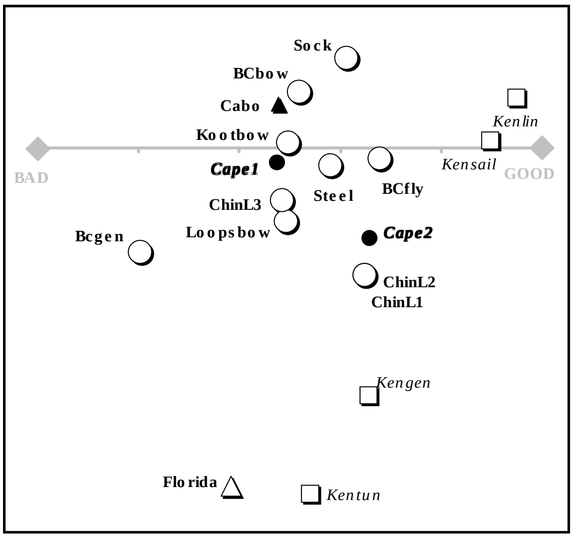

Figure 1. Fishing experience ordinated by the Rapfish method for 17 sport fisheries. Horizontal axis (grey) indicates status, from worst (left) to best (right). Vertical axis expresses other distinguishing features uncorrelated with status. Symbols indicate different countries. Fisheries are: **Florida** = Florida, USA, multispecies marine; **Cabo** = Cabo san Lucas, Mexico, marlin; **Cape1, Cape2** = Cape Town, gamefish, respondents 1 and 2; **Kenlin, Kensail, Kentun, Kengen** = southern Kenyan coast marlin, sailfish (northern coast), yellowfin tuna, gamefish; **BCgen** = all southern British Columbia (BC) sport fisheries, (older fisher); **Bcbow** = BC rainbow trout small lakes; **Loopsbow** = Kamloops rainbow trout; **Kootbow** = Gerard rainbow trout, Kootenay Lake, BC; **BCfly** = BC fly fishing; **Steel** = BC steelhead (sea-going rainbow trout); **sock** = BC sockeye; (all from fisher/managers) **ChinL1, ChinL2, ChinL3** = three BC marine lodges, salmon (fishers).

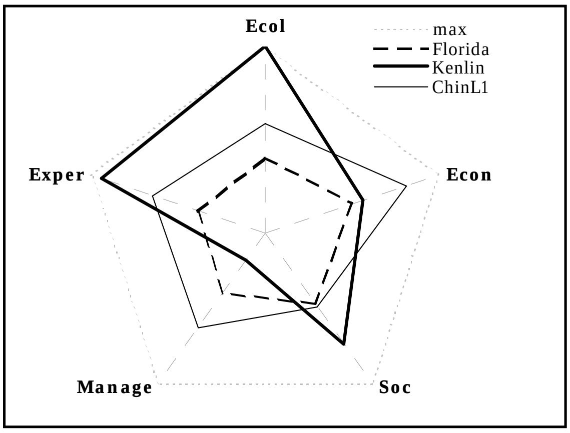

Figure 2. Rapfish kites can provide a characteristic multi-disciplinary signature for perceived fishery status. Here a five-point Rapfish kite diagram summarizes three selected fisheries. Each of the five axes represents a status score obtained from a Rapfish ordination in one of the five evaluation fields, as indicated by the labels. Maximum possible scores lie on the outer rim. Fisheries are: **Florida** = multispecies marine; **Kenlin** = southern Kenyan coast marlin, **ChinL1** = a BC marine gamefish lodge.

The most interesting results came from ranking the fisheries using the status scores in each field. Kenyan fisheries (two respondents, four fisheries) rated highly in all fields except management, which one respondent noted was “virtually absent”. The Florida USA multi-species fishery ranked in the lowest quartile in two fields and in the lowest third in the other three fields, ranking lowest overall. Table 1 shows the correlation coefficients among the ranks of fisheries in the five evaluation fields. Fishing experience corre-

Table 1. Spearman correlation coefficients among rankings of 17 fisheries on five Rapfish evaluation fields. Open box = significant at 95% level (2-tailed). Shaded box = significant at 99% level (2 tailed tests).

	economic	social	management	experience
economic	0.29			
social	0.51	0.19		
management	-0.09	0.26	0.29	
experience	0.71	0.63	0.56	0.26

lated very significantly with perceived ecology and economic status, and significantly with social status, but not at all with management performance. The work reported here is a pilot study using a small number of respondents. A full survey using this 'Rapfish for Sport Fisheries' could examine the distribution of scores across different angler groups, and the view of the general public could also be included.

Anglers can act not only as willing sentinels of abundance and change, but also as providers of well-managed data records and tag returns. Can sport fishers help responsible fisheries by providing good data? An early example was the use of the Kenyan sport catch of yellowfin tuna which allowed the estimation of age specific, annual, total mortality rates and hence provided an annual stock assessment (Pitcher and Hemphill, 1989). Indian Ocean yellowfin tuna were found to be overexploited long before official stock assessment based on commercial catch rates came to the same conclusion, but the method appears not to have been followed up.

In British Columbia (BC), the sport fish catch is estimated in two ways. Official catch figures are provided by a regional creel census (including helicopter surveys) and log books from lodges and fishing guides provide annual figures. But these data are regarded as suspiciously low by commercial fishers and others. Every five years a Canadian government questionnaire reaches 15,000 anglers, including those who have visited BC from foreign countries. Angler survey data, adjusted statistically for non-respondents, reports up to double the catch estimated by creel. The angler survey data match better with a number of indicators, including cross-border records of halibut and chinook salmon reported to US border patrols and other estimates of fishing mortality.

So, the good news is that data from anglers can help in managing responsible fisheries. But the bad news is that, for some species, like coho and chinook salmon, relatively unregulated anglers can impose a higher mortality than commercial fisheries, which are heavily regulated. Likewise, in the USA, anglers impose a higher mortality than commercial fisheries for ten key species, and for four of these (dolphin fish, *Coryphaena*; yellowtail, *Seriola*; spotted sea trout, *Cynoscion* and red drum, *Sciaenops*), significantly more (Gentner and Lowther, 2002).

In conclusion, in order to be compleat in a depleted and threatened ocean, modern day anglers need to pursue their sport following ethical guidelines. Moreover, anglers have to begin to evaluate their ethical status and their compliance with the FAO Code of Conduct, as adapted for sport fisheries. Compleat anglers will ensure that the perception of sport fishing has high ecological, economic, and social status. They will also evaluate management performance in achieving a positive perception amongst anglers, managers and the general public. Compleat anglers will take a full role in a modern thalassocracy of respect and care for fragile aquatic ecosystems threatened by human activity. As Isaak Walton says at end of his book: "[The Lords praise] on all lovers of virtue, and [who] dare trust in his providence, and be quiet, and go a-angling"

References

Aas, Ø; Thailing, C and Ditton, RB, 2002. Controversy over Catch-and-Release Recreational Fishing in Europe. In: *Recreational Fisheries: Ecological, Economic and Social Evaluation*, eds Pitcher TJ and Hollingworth CE. Chapter 7, pp 74–94. Blackwell Science, Oxford, UK.

Aas, Ø, 2002. The Next Chapter: Multicultural And Cross-Disciplinary Progress. In: *Recreational Fisheries: Ecological, Economic and Social Evaluation*, eds Pitcher TJ and Hollingworth CE. Chapter 17, pp 252–263. Blackwell Science, Oxford, UK.

Christensen V, Guénette S, Heymans J, Walters CJ, Watson R, Zeller D and Pauly D, 2001. Estimating Fish Abundance of the North Atlantic, 1950–1999. In: *Fisheries impacts on North Atlantic ecosystems: models and analyses*, Guénette S, Christensen V and Pauly, D (eds), pp 1–25. Fisheries Centre Research Reports 9(4).

Chuenpagee R, Knetsch JL and Brown TC, 2001. Environmental Damage Schedules: Community Judgments of Importance and Assessments of Losses. *Land Economics* **77**(1):1–11.

Coward H, Ommer R and Pitcher TJ (eds), 2000. *Just Fish: the Ethics of Canadian Fisheries.* Institute of Social and Economic Research Press. St John's, Newfoundland, Canada.

Ditton RB, Holland SM and Anderson DK, 2002. Recreational Fishing as Tourism. *Fisheries* **27**:17–24.

Doulman D, 1998. The Code of Conduct for Responsible fisheries: the requirement for structural change and adjustments in the fisheries sector. [FAO Website].

Duffield JW, Merritt MF and Neher CJ, 2002. Valuation and Policy in Alaskan Sport Fisheries. In: *Recreational Fisheries: Ecological, Economic and Social Evaluation,* Pitcher TJ and Hollingworth CE (eds). Chapter 13, pp 156–185. Blackwell Science, Oxford, UK.

FAO, 1995. *Code of Conduct for Responsible Fisheries.* FAO, Rome.

—— 1999. The development and use of Indicators for sustainable development of marine capture fisheries. *FAO Technical Guidelines for Responsible Fisheries No 8.* FAO, Rome.

Forrest R and Pitcher TJ, 2002. What is the BC sport fish catch? In: *Back to the Future: Policies for the Restoration of Marine Ecosystems*, Pitcher T and Haggan N (eds). Fishery Centre Research Reports 10, (in prep).

Gentner B and Lowther A, 2002. Evaluating Marine Sport Fisheries in the USA. In: *Recreational Fisheries: Ecological, Economic and Social Evaluation,* Pitcher, TJ and Hollingworth CE (eds). Chapter 14, pp 186–206. Blackwell Science, Oxford, UK.

Griffiths MH and Lamberth SJ, 2002. Evaluating a marine sport fishery in South Africa. In: *Recreational Fisheries: Ecological, Economic and Social Evaluation,* Pitcher TJ and Hollingworth CE (eds). Chapter 16, pp 227–251. Blackwell Science, Oxford, UK.

Jones R and Williams-Davidson T-L, 2000. Applying Haida ethics in today's fishery. In: *Just Fish: the ethics of Canadian fisheries,* Coward H, Ommer R and Pitcher TJ (eds), pp 101–115. Institute of Social and Economic Research Press. St John's, Newfoundland.

Kearney RE, 2002. Recreational Fishing: Value is in the Eye of the Beholder. In: *Recreational Fisheries: Ecological, Economic and Social Evaluation,* Pitcher TJ and Hollingworth CE (eds). Chapter 2, pp 17–33. Blackwell Science, Oxford, UK.

Knetsch JL, 1994. Environmental valuation: some problems of wrong questions and misleading answers. *Environmental Values* **3**:351–66.

Lyle JM, Coleman APM, West L, Campbell D and Henry GW, 2002. New large-scale survey methods for evaluating sport fisheries. In: *Recreational Fisheries: Ecological, Economic and Social Evaluation,* Pitcher TJ and Hollingworth CE (eds). Chapter 15, pp 207–226. Blackwell Science, Oxford, UK.

Lyons J, Hickley P and Gledhill S, 2002. An Evaluation of Recreational Fishing in England and Wales. In: *Recreational Fisheries: Ecological, Economic and Social Evaluation,* Pitcher TJ and Hollingworth CE (eds). Chapter 12, pp 144–155. Blackwell Science, Oxford, UK.

OED, 1999. Oxford English Dictionary (2nd edition). Oxford University Press, Oxford, UK. [CD-Rom].

Pauly D, Christensen V, Dalsgaard J, Froese R and Torres F Jnr, 1998. Fishing down marine food webs. *Science* **279**:860–863.

Pitcher TJ, 1999a. Fishing for Fun, Food and Profit. In *Evaluating the benefits of Recreational fisheries,* Pitcher, TJ. (ed.). Pp 5–8. Fisheries Centre Research Reports 7(3).

—— 1999b. *Rapfish, A Rapid Appraisal Technique For Fisheries, And Its Application To The Code Of Conduct For Responsible Fisheries*. FAO Fisheries Circular No. 947, FAO, Rome.

—— 2000. Fisheries management that aims to rebuild resources can help resolve disputes, reinvigorate fisheries science and encourage public support. *Fish and Fisheries* **1**(1):99–103.

—— 2001. Fisheries Managed to Rebuild Ecosystems: Reconstructing the Past to Salvage The Future. *Ecological Applications* **11**(2):601–617.

Pitcher TJ and Hemphill S, 1989. Stock assessment of Indian Ocean yellowfin tuna based on data from a sport fishery. *Fishbyte* **7**(3):15–17.

Pitcher TJ and Power MP, 2000. Fish Figures: Quantifying the Ethical Status of Canadian Fisheries, East and West. Pages 225-253 In: *Just Fish: ethics and Canadian marine fisheries,* Coward H, Ommer R and Pitcher TJ (eds). Institute of Social and Economic Research Press. St John's, Newfoundland.

Pitcher TJ and Preikshot DB, 2001. Rapfish: A Rapid Appraisal Technique to Evaluate the Sustainability Status of Fisheries. *Fisheries Research* **49**(3):255–270.

Pitcher TJ and Hollingworth CE, 2002. Fishing for Fun: What's the Catch? In: *Recreational Fisheries: Ecological, Economic and Social Evaluation,* Pitcher TJ and Hollingworth CE (eds). Chapter 1, pp 1–16. Blackwell Science, Oxford, UK.

Policansky D, 2002. Catch-and-Release Recreational Fishing: a Historical Perspective. In: *Recreational Fisheries: Ecological, Economic and Social Evaluation,* Pitcher TJ and Hollingworth CE (eds). Chapter 6, pp 95–106. Blackwell Science, Oxford, UK.

Rudd MA, Folmer H and van Kooten GC, 2002. Economic Evaluation of Recreational Fishery Policies. In: *Recreational Fisheries: Ecological, Economic and Social Evaluation,* Pitcher TJ and Hollingworth CE (eds). Chapter 3, pp 34–52. Blackwell Science, Oxford, UK.

Steffans W and Winkel M, 2002. Evaluating recreational fishing in Germany. In: *Recreational Fisheries: Ecological, Economic and Social Evaluation,* Pitcher TJ and Hollingworth CE (eds). Chapter 10, pp 130–136. Blackwell Science, Oxford, UK.

Sullivan M, 1999. How and why Fishers Lie and Cheat. In: *Evaluating the Benefits of Recreational Fisheries,* Pitcher TJ (ed.). Pp 165–166. Fisheries Centre Research Reports 7(2), University of British Columbia, Vancouver. (Abstract and discussion only).

Toivonen A-A, 2002. A Survey of the Economic Value of Nordic Recreational Fisheries. In: *Recreational Fisheries: Ecological, Economic and Social Evaluation,* Pitcher TJ and Hollingworth CE (eds). Chapter 11, pp 137–143. Blackwell Science, Oxford, UK.

Walton I and Cotton C, 1676. *The Compleat Angler, or The Contemplative Man's Recreation*. 1st edn. 1653; 2nd edn. 1676.