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Introduction to the collected works of R.E. Johannes, publications on marine traditional knowledge and management¹

Kenneth Ruddle²

Robert E. Johannes was a tropical marine ecologist who, from the mid-1970s, pioneered the idea of integrating for resource conservation the specialized ecological knowledge and traditional marine resource management systems of Pacific Island fishing communities with Western concepts of scientific management. In so doing he highlighted the importance of indigenous knowledge and community-based systems as key factors in marine conservation.

Although they are among the most biologically productive communities, coral reefs seem to be particularly vulnerable to overharvesting. Johannes sought to understand why. So he went to Palau in the mid-1970s to test an ecological hypothesis that might explain the upper limits on the harvest of fish in coral reef communities: "But after a few weeks I became aware of various political, cultural, and economic pressures impinging on fishing in such a way as to make my purely biological explanation seem quite simplistic." (Johannes 1981:x).

As a result of his 16 months experience in Palau and the South West Islands, Johannes became deeply involved in halting the erosion of what he considered invaluable traditional ecological knowledge in fishing communities, and applying it directly to improve marine resource management. At the same time he helped build local capacity to do this and to spread the word. Doing this, however, incurred major professional risks and invited the scorn of his marine biologist colleagues, a number of whom regarded him as a drop-out. But he felt more than compensated by the admiration of Palauan villagers, who commented that although fisheries researchers had visited them before and held forth about their knowledge, Johannes was "the first who ever asked us about *our* knowledge." That vital difference in attitude and approach opened wide doors throughout the Pacific Islands and beyond. Johannes described his Palauan research in the now classic "Words of the Lagoon: Fishing and Marine Lore in the Palau District of Micronesia", published by the University of California Press in 1981.

The essence of Johannes' approach can be summarized fairly simply. Coral reef fish resources present complex and unfamiliar challenges to fisheries management because, unlike temperate latitudes, there are far more species, and fisheries are not dominated by an overwhelming few. So it is almost impossible for managers to understand rapidly the biology of even the most important of the hundreds of species caught. However, a short-cut resides in the minds of small-scale nearshore fishermen, who are especially rich sources of unrecorded knowledge. Nevertheless, little effort had been made to record this information before the 1970s: anthropologists researching in the Pacific Islands focused largely on terrestrial ecosystems, whereas "natural scientists have routinely overlooked the practical knowledge possessed by artisans...It is one manifestation of the elitism and ethnocentrism that run deep in much of the Western scientific community" (Johannes 1981:ix).

As a consequence, marine resource development and management schemes often fail because they are designed with little understanding of resource users, the ecological settings in which they operate and their cultural milieu. Working with small-scale tropical fishermen can yield information on such usually "hidden" factors as unappreciated resource areas and their vulnerability to damage through coastal development, important aspects of the biology of target species, local oceanographic phenomena, the cultural acceptability of proposed management schemes, and valuable traditional conservation practices. Local knowledge is particularly important where formally recorded data are lacking (see, for example, Johannes 1981b). In particular, fishermen's knowledge of the seasonality of activities of marine fauna would likely be superior to that of consultants, since it would be based on year-round observation and therefore comprehensive. In contrast, consultants might turn up at the wrong season and so miss some critical activity. For example, knowledge of lunar cycles is invaluable for the protection of breeding grounds which

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2. Asahigaoka-cho 7-22-511, Ashiya-shi, Hyogo-ken, Japan 659-0012. Email: mb5k-rddl@asahi-net.or.jp

would rarely be discovered without the knowledge of local fishermen. Johannes' pioneering research popularized awareness of spawning aggregations and explained in practical detail how the predictable spawning aggregations provide exceptional opportunities for fisheries management (Johannes 1978, 1980, 1989).

Aware that the rapid disappearance of traditional knowledge and the lack of interest of younger people in acquiring it was a serious constraint on implementing his approach, Johannes sought to create a widespread awareness of this often encyclopedic knowledge base. He advocated a reawakening of traditional environmental ethics among youth and hereditary chiefs related to their exclusive reef and lagoon tenure, an ancient form of marine protection which, he contended, provides a practical and time-tested model of "limited entry" that Western fisheries biologists and economists were only then hitting on as an innovative way to manage their own fisheries.

The relative success of indigenous management contrasted with western-style management

In the late-1970s Johannes introduced the concept of national indigenous marine resource rights, which then were accorded low priority by legislators and maritime legal specialists preoccupied with the international aspects of the Law of the Sea (Johannes 1977, 1978b). Indigenous law and Western legal and property concepts were at odds, with the Westerners assuming the universal validity of theirs and regarding others as primitive. A constant theme of Johannes is that in this instance traditional Western laws are primitive. He argued that this difference arose because Pacific Islanders knew their resources were finite and their traditional laws reflect this knowledge. In contrast, the continentally oriented Westerners were unaware of resource scarcity, and their laws and attitudes reflected an abundance characteristic of a continental situation.³ Compared with Pacific Islanders, who long ago understood resource scarcity, Westerners have only relatively

recently had to confront the now obvious impact of their own overfishing on continental shelves:

In summary, Pacific Islanders discovered the cornerstone of sound fisheries management, in the form of reef and lagoon tenure, centuries before any form of marine fisheries management was seriously considered in the West. Difficulties arising from conflicts between traditional marine tenure systems and westernization and commercialization of island fisheries have resulted in its destruction in some areas and the threat of destruction in others. Where it still exists, it seems clear that the system must undergo some alterations in order to accommodate twentieth century pressures on it. However, the destruction of the system will ultimately create more numerous and fundamental fisheries management problems than its solves (Johannes 1977:126).

Nevertheless, a clear temptation to either weaken or invalidate traditional tenure in Pacific Island fisheries was apparent. To Johannes that was a serious mistake, and he asserted that reef and lagoon tenure and other traditional conservation measures were effective because "most Pacific Island marine conservation measures, when applied judiciously, serve the purposes for which they were designed" (Johannes 1978b: 356). However, where traditional conservation rules have been either weakened or forcibly abolished, marine resources have subsequently been over-exploited. Therefore Pacific Island governments need to support the best of these customs, because Western-style management is not sound for tropical nearshore fisheries. It is important that Pacific Island governments ensure traditional mechanisms of resource management and conservation, or at least some mutually agreed modification of them, become integrated within national fisheries policy and development projects (Johannes 1982a).

3. Johannes addressed the question of whether or not Pacific Islanders possessed a traditional conservation ethic (1978a), by which he meant "an awareness that one can deplete or otherwise damage one's natural resources, coupled with a commitment to reduce or eliminate the problem" (Johannes 1994b, 2003:115). He also speculated on why Pacific Islanders developed sound methods of protecting marine resources, when their record of exterminating terrestrial species is so bad. Johannes suggested that the answer to the second part was because it is easy for islanders to unwittingly exterminate birds and other island megafauna "because of their very low reproductive output" (*Ibid.* 114). Extinctions of such creatures could have happened so fast that the islanders failed to comprehend the need for conservation until it was too late" (*Ibid.* 115). "But although it was possible to severely deplete nearshore marine stocks, it was nearly impossible to exterminate most marine species... even after severe overharvesting populations of fish and most edible invertebrates will often rebound within a few years when given adequate protection. In short, the time in which islanders could develop an awareness of the need for conservation before doing irreversible damage to their seafood stocks was much longer than it was for land animals." (*Ibid.*). Islanders may well see the limits more easily than Continental people do, and if this is true it would only be because islanders often exceeded the limits more easily than did Continental peoples. "Because of their very different geographical setting, many Pacific islanders simply bumped into their marine environmental limits much earlier than Europeans did, and the island residents did what common sense dictated under the circumstances: invented marine conservation." (*Ibid.*). But it is important to note that bad environmental practices were also commonplace in Pacific islands and that constructive and destructive practices coexisted.

Johannes contended that any Western type of fisheries management introduced as a replacement would be ineffective in Pacific Islands. The main reasons were:

- (1) that the great number of species in tropical inshore fisheries would require very many more regulations and much greater enforcement to achieve the same goals as were already reached using traditional tenure;
- (2) that fisheries management knows much less about tropical than temperate species and therefore is not equipped to handle tropical fisheries, and, because of its huge data requirements, would be infeasible (*vide infra*);
- (3) that there are many more boats, gear types and fishermen in tropical inshore fisheries than in Western commercial fisheries;
- (4) that government law enforcement is of notoriously limited capacity in many Pacific Island States, and would be evaded by resentful fishermen; and
- (5) that Pacific Island governments lack the money and trained specialists to cope with a Western-style of fisheries management.

Beyond that, Johannes elaborated the additional complexities in Pacific Island nearshore fisheries that present Western and Western-trained economists with unusual conditions, some of which may preclude economically sound fisheries development (Johannes 1989a). Such impediments include the general impossibility of obtaining at reasonable cost the information on catch, effort and stocks required for sound management, in the conventional Western sense of the term. In addition, social barriers to capitalistic behavior are also widespread, and occupational pluralism the norm. However, in compensation the fisheries manager has unusual opportunities compared with other parts of the world to build on indigenous marine resource management systems and on rich indigenous knowledge bases. But the record of development projects in the Pacific islands is poor in terms of both economic performance and social and economic impacts. "Fisheries development," particularly if it implied development of large-scale external markets for reef and lagoon finfish, the most important traditional marine resource of Pacific Islanders, should be undertaken with caution. "The biological, social and economic stumbling blocks are too many and too complex to surmount collectively in the foreseeable future. Most private and government capital that has been sunk into reef and lagoon finfisheries development in the islands were indeed just that — sunk." (Johannes 1982b: 247).

In short, westerners are quite unable to manage multi-species tropical demersal species on an efficient scientific

basis and it will be many decades, it ever, before we are able to do so. Of necessity in the meantime, our prescriptions are based largely on intuition and good intentions. As a consequence our failures are legion, our successes rare. Traditional Pacific island management customs take on added appeal when we consider our own dismal record (Johannes 1977:125).

Constraints on that potential

Johannes identified six main constraints on the application of traditional knowledge and management to modern fisheries conditions. His concern with some is evident from the first works of the 1970s, but others became more explicitly stated as Johannes' frustrations emerged with an unwillingness to change. The main constraints identified are:

- (1) The unwillingness of fisheries scientists to countenance the use of indigenous knowledge;
- (2) The failure to appreciate differences between temperate zone industrial fisheries and tropical nearshore fisheries;
- (3) The issue of empowerment and who really needs to be empowered;
- (4) Ethical issues regarding indigenous knowledge; and
- (5) Idealizing TEK, or intellectual dishonesty and uncritical acceptance of indigenous knowledge
- (6) Problematical social scientists.

1. *The unwillingness of fisheries scientists to countenance the use of indigenous knowledge*

Johannes was quite simply frustrated by the stubbornness of the scientific establishment. He observed, for example, that although 2,400 years ago fishermen on the island of Lesbos taught Aristotle about the lunar periodicity of roe development in sea urchins, it was only in the nineteenth century that researchers confirmed the same information to the "satisfaction of the scientific community" (Johannes 1994c:82). Further, while Johannes was in Palau in the mid-1970s local fishermen explained to him the lunar periodicity and location of spawning aggregations of some 55 species of food fish, or is it turned out, twice as many species of marine animals as biologists had then described for the entire world!

But his appreciation for fishermen's knowledge was not widely shared:

Some of my biologist colleagues have little interest in traditional environmental knowledge such as that possessed by Pacific Islanders.

They dismiss such knowledge, gained during centuries of practical experience, as anecdotal, although their own specialized knowledge is based largely on studies carried out over much shorter time periods under conditions where being wrong did not involve the risk that they and their families would go hungry (*Ibid.*:81).

The problem quite simply was that:

Many biologists ... insist that true science must involve controlled experimentation and rigorous statistical testing of null hypotheses. According to these criteria, much of what is being discussed here, the Science of Pacific Island Peoples, is not really science at all. For we who value such knowledge there is no need to feel defensive. We are in good company. Conveniently overlooked by some who champion this falsificationist definition of science is the fact that it also excludes not only much social science, but also most of oceanography, geology, meteorology, and astronomy as well as large portions of ecological and evolutionary research (*Ibid.*).

A further frustration was that local scientists educated in the West have largely adopted the same attitudes: "colonial bodies are being replaced, but scientific colonialism lingers" (Johannes 2003a:119). So much so, Johannes lamented, that university educated local fisheries researchers do not even imagine the value of their elders' knowledge.

In contrast, Johannes' approach was straightforward and inclusive. "For my purposes anything that contributes to our knowledge of the physical world is part of science. This definition ignores distinctions based on how this knowledge is obtained. The important criterion is whether it provides us with understanding." (Johannes 1994b).

2. The failure to appreciate differences between temperate zone industrial fisheries and tropical nearshore fisheries

Westerners, both fisheries biologists and fisheries social scientists alike, are generally unaware of the fundamental differences between tropical small-scale nearshore fisheries and their own industrial fisheries. In part this accounts for the misguided development policies implemented in tropical nearshore fisheries. Further, Western fisheries textbooks deal almost exclusively with temperate zone fish-

eries, and so are inappropriate for training tropical fisheries managers. Nevertheless, they continue to be used to train them (Johannes 2003a).

There are major differences between tropical nearshore fisheries and temperate industrial fisheries. First, in the tropics nearshore fisheries are typically far more numerous in terms of per unit of fish catch or areas fished, numbers of fish species, gear types, number and location of landing sites, and distribution channels.

Second, in many tropical areas marine tenure with associated rights limiting entry has been customary for centuries. But an all too common generalization is that the problem with fisheries lies in their open access nature. This is simply not true for many parts of the world, although it often is the case in the temperate zones, where the writers of fisheries management textbooks received their formal training and fisheries experiences.

Third, most tropical small-scale fishermen, at least those in the Pacific Islands, operate in clear and shallow nearshore waters and so are physically closer to their prey than are industrial fishers. Based on visual sightings, they pursue fish closely with hand held gear, unlike industrial fishers who operate from wheelhouses based on information provided by echo sounders.

Fourth, tropical small-scale fishermen mostly seek to provision just their households or their community, except for very valuable items of their catch. Activities are generally operated on a kinship basis, as are distribution channels, and the fishery is usually under-capitalized. The profit motive is not overriding. In contrast, it dominates in industrial fisheries which are aimed at supplying national or international markets, and in which kin relationships usually mean little.

Fifth, traditional fisheries management in the tropics is based almost entirely on such qualitative controls as closed seasons and closed areas. Of course, this is probably because quantitative management has been infeasible in such fisheries. "Indigenous knowledge tends to be qualitative. Biological management here is not about achieving optimum sustainable yields; it is about preventing serious declines." (*Ibid.*:18). Although industrial fisheries management has focused almost entirely on population dynamics and physical dynamics of fish stocks and on the quantitative regulation of stock removal, it is now increasingly realized that this is infeasible, even in most industrial fisheries.

Finally, whereas industrial fisheries are dominated by large corporate fleets that traverse the world, local fishers invariably stick with local grounds,

from which outsiders are excluded. This means that they inherit a long and often encyclopedic history of local knowledge about the intimate details of their local area. This is not usually the case with industrial fisheries.

3. The issue of empowerment and who really needs to be empowered

Researchers in industrial fisheries often generalize about the need to “empower” fishers, or about the need to “let fishers in on the management process” (*Ibid.*:15). This is arrant nonsense when applied to many parts of the world where fisheries management has been in the hands of fishermen for centuries, and where they have been therefore empowered for a similar length of time.

Since tropical nearshore fisheries are characterized by vastly more fish species and their corresponding fishing methods than temperate fisheries, and because there are very many more small landing points and complex social distribution systems than in temperate fisheries, central government management would be basically infeasible, despite its advocacy by Western fisheries development advisers. As a consequence, villagers in some Pacific island countries commonly make more formal fisheries regulations than do governments. Although governments may still pass laws about local fisheries, these are commonly ignored in places like the Solomon Islands, where individual fisheries officers with a small canoe and an insufficient fuel budget cannot be expected to manage the large districts for which they are nominally responsible. So to press for central administration or even co-management under such conditions is laughable. The most that can be hoped is that villagers will enforce those government laws they see as beneficial to them. Thus, Johannes continued, rather than the fishermen it is the fisheries managers and fisheries researchers from government who need to be “let in on the management process” (*Ibid.*:16).

Johannes also noted that unlike some industrial fisheries in temperate regions under co-management arrangements, where, when fisheries researchers recognize their own limitations, they often invite fishermen into the management process, quite the opposite situation usually prevails in tropical small-scale fisheries. In many Pacific Island nations it is the fishermen who invite fisheries managers to participate with them in devising new management solutions for their own traditional fisheries. This occurs particularly when fishermen realize that their own traditional measures and knowledge, while still adequate for many purposes, are no longer ap-

plicable under increasing human population pressure, or for managing new technologies, or where new export markets have arisen and a cash economy developed, among other impacts resulting from Westernization.

4. Ethical issues regarding indigenous knowledge

Johannes was deeply concerned about the misappropriation of traditional ecological knowledge (TEK). The main issue is whether outside corporations would seek to exploit local knowledge for their profit and also, in certain situations, whether external managers would seek to use the knowledge to impose stricter regulation on local or indigenous people.⁴

However, this did not lead him to adopt an extreme position, since not all indigenous peoples were preserving their traditional ecological knowledge effectively. The optimal solution would be to ensure that young people record and retain their traditional knowledge within their culture. However, that takes time and revitalization of knowledge transmission mechanisms, and, because TEK is being lost at an alarming rate, it is important that an outsider performs that role when local people display no interest in safeguarding and ensuring its continuity.

Moreover, since it is now generally acknowledged by both indigenous people and outsiders alike that, in the context of modernized fisheries, TEK works best when it is blended with Western science, the issue becomes not one of limiting the circulation of traditional knowledge among members of the culture group, but of getting it as quickly as possible into the most practical situation to solve immediate problems. However, the formalized protection of TEK from expropriation would assist in engaging many more communities to openly discuss their knowledge, thereby making it available for use in fisheries management. This remains a critical challenge to be met in promoting the widespread use of TEK in the Pacific and elsewhere.

5. Idealizing TEK, or intellectual dishonesty and uncritical acceptance of indigenous knowledge

In this risk-averse era, when political correctness frequently stifles intellectual sincerity, it is indeed refreshing to reread Johannes’ clear and comprehensive condemnation of what he regarded as intellectual dishonesty. He was not afraid to confront its various forms.

In particular, Johannes was well aware of the dangers and dishonesty of the uncritical acceptance and

4. In other words it would allow non-indigenous managers to refine their science-based management based on local knowledge (Johannes 1994c).

romanticization of traditional ecological knowledge, and that “uncritical appreciation can be almost as bad as none at all” (Johannes 1994b:86), such that “(s)ome claims about the environmental wisdom of traditional peoples have been so overblown that they have provoked a backlash” (*Ibid.*:87). With respect to romanticization and the mythical golden age of TEK, he took the commonsensical middle course, and concluded that the “truth lies somewhere in between: valid and invalid environmental beliefs, wise and unwise environmental practices coexist in many if not most cultures. People learn from their excesses. To assume differently is to assume that indigenous peoples are, in general, either inherently superior, or inferior, to the cultures of the developed world” (*Ibid.*). He observed a serious deficiency in the literature on TEK in the absence of any effort to determine validity, with local people being little different from those in developed countries in the desire to get the facts right or to embellish them as pretended experts (Johannes 1993).

Johannes excoriated environmental and social activists who quickly recognized the powerful rhetorical tool that the concept of traditional resource management and TEK researchers provide, but then often selectively use only those facts that accord with their case. An egregious example is the shameless conflating of an imputed sacredness with profound ecological wisdom. Although nature and religion might be more intimately intertwined in a local culture than in Western societies, environmental activists have not shrunk from the “convenient but tenuous extrapolation from this by routinely referring to TEK and indigenous attitudes towards nature as ‘sacred’”, or by employing such phrases and terms as “sacredness of ecological systems” or “sacred ecology” of indigenous peoples (Johannes 2003b: 120). Such deceitfulness is regrettable, for:

Because of such ploys, the notion of indigenous peoples as environmental paragons living in preternatural harmony with nature has metastasized through the media, and indigenous peoples are now often presented to us as environmentalist role models (*Ibid.*).

This urge to select and embellish the facts is not limited to Western environmental activists. Observing the resonance of such environmental rhetoric among Westerners, some indigenous people have adopted it. And this has brought the inevitable temptation to use it to influence the outcomes of resource management or development initiatives in favor of islanders. For example they may exaggerate the environmental significance of an area being

considered for development to extract greater concessions from the government or developers (*Ibid.*:121).

6. Problematical social scientists

Although proud of his collaboration with social scientists, Johannes identified some of their activities as obstructionist or otherwise problematical. Regarding the recent florescence of village-based marine resource management in Vanuatu and other Pacific island nations (Johannes 1998a), he noted that this continued growth of community-based marine resource management further refutes the idea that traditional non-Western attitudes toward nature cannot provide a sound basis for the modern day management of natural resources, and enabled Johannes to take the stick to a:

small but destructive group of anthropologists...(who)...maintain that building contemporary conservation on traditional natural resource management is bound to fail because of differences between Western and indigenous concepts of nature. This is an astonishing generalization, coming as it does from a profession that normally serves to restrain Western ethnocentrism, for it implies that only Westerners are capable of deducing the connection between harvesting pressure and natural resource availability. No one has been more outspoken on this issue than Dwyer (1994:91) who has claimed that, “to represent indigenous management systems as being well-suited to the needs of modern conservation, or is founded on the same ethic, is both facile and wrong”. This opinion arises from generalizing too freely from experience gained in certain cultures for which the statement may well be true. (Johannes 2002:337).

He also noted a further problem related to the uncritical and naïve assumption by some anthropologists “that superstitions and myths concerning the environment embody functional environmental adaptations. Probably some do, but the generalized attribution of environmental utility to such beliefs does not deserve serious scrutiny. Moreover, locally prescribed methods for improving fishing or hunting that focused on propitiating spirits or counteracting the effects of sorcery can divert attention from real and sometimes correctable causes.” (Johannes 2003b:122).

Worse than mere naïveté is that with its own taboos social science is replete with intellectual dishonesty.

In particular, he roundly condemned one such taboo that "... prohibits many from acknowledging that there are traditional maladaptations in non-Western cultures...Perhaps to minimize the exploitation of observations by racists--or to avoid being labeled as racist... many anthropologists, for example, maintain the fiction that all cultural practices are beyond censure..." (*Ibid.*:121).

He noted that this particular taboo raises the especially vexing ethical issue of whether or not important judgments concerning human behavior should be suppressed because they might inflate racism, and, if respect for the customs of others is a hallmark of a civilized society, whether unlimited, uncritical respect is also civilized. Johannes observed that although the "widespread public discussion of certain clearly maladaptive cultural practices, such as female genital mutilation, would seem to have made cultural relativism increasing less tenable in recent years...it seems to have retained its currency among many anthropologists, including some who address environmental issues." (*Ibid.*:122).

Such naïveté has led to some severe and perhaps unanticipated problems in Pacific Island nations. For example:

some island elites have been quick to exploit the cultural relativist stance that they have picked up from anthropologists who have been ubiquitous in the Pacific islands for several decades. Elites use this position not only to warn off outside critics but also to justify their exploitation to their own people (Lawson 1996). Serious environmental harm is being done in Oceania, most visibly in Melanesia, by island leaders who take advantage of their traditional environmental stewardship responsibilities and allow multinationals in to rip off the people's natural resources. (Johannes 2003b).

In the same general fashion, fisheries resources in some Pacific islands have been sacrificed to enrich leaders. For example, exporting live reef food fish to Southeast Asia has become a big industry in recent years. If allowed to proceed without proper controls, it results in severe fish stock depletion as well as other serious environmental and socioeconomic damage...Cultural relativism impedes efforts to address such practices (*Ibid.*:123).

And the final irony is that "emboldened indigenous politicians who despoil their islands' natural

resources tell critics, 'stay out of this. You don't understand our culture. These actions are in accord with our traditional customs.' Yet, as Lawson (1996) points out, members of Pacific islands elites are often among those islanders most out of touch with their traditions." (*Ibid.*).

Requirements for the future

Since it is impossible to manage most marine fisheries to achieve optimum yields, the only practical option is to adopt a precautionary approach that aims to protect resources from serious depletion. Because manpower and funds are not available to produce scientific data for each managed fishery, it is necessary to go beyond precautionary management to data-less management. For example, Johannes made back-of-the-envelope calculations to demonstrate that, in countries like Indonesia, underwater censuses using transect surveys would be infeasible and that Rapid Rural Appraisal of fishing villages would be even less realistic. The recourse would be to use data-less management, which, of course, is the universal traditional system of management employed for centuries by indigenous fishermen all over the world (Johannes 1998b).

Similarly, his field research on traditional knowledge demonstrated that random sampling of interviewees and a rigorous statistical analysis of the data obtained was likely to yield inaccurate and misleading data. Rather than use randomly select informants, Johannes found it is more valuable to interview people with:

...high reputations in the villages for fishing expertise. For the most part these people were between 42 and 79 years of age. Some of them no longer fish because of physical infirmity, but all maintained an active interest in fishing and in the changes in fishing conditions occurring over the years. The attitudes and knowledge revealed by these interviews should not be assumed to be representative of Tarawa's fishing communities as a whole, but of their most experienced fishermen.

Interviews were deliberately unstructured. When unanticipated but promising subjects came up we pursued them with further questions, thus following any potentially instructive pathways along which the interviewee's knowledge seem to be leading us. To minimize the constraints put on informants by the limitations of our own knowledge and preconceptions, we did not use questionnaires or a sur-

vey-style format. The latter are useful in pursuing well-defined and circumscribed questions; they are inappropriate, however, in exploratory interviews concerning specialists' knowledge where the interviewer is uncertain concerning what types of useful information may be forthcoming (Johannes and Yeeting 2000:1–2).

To capture the vital information that would be missed otherwise, Johannes was adamant about the importance of including alternatives to complement random sampling of fishermen within the design of field surveys. However, he realized that this would require a major shift in the thinking and training for biological scientists to enable them to embrace data-less and data-poor management, as well as rewriting textbooks to acknowledge and include it together with conventional statistical approaches. That would not be easy, because "the brainwashing we have received from narrowly trained and dogmatic teachers, entranced by the theoretical appeal of statistical analysis of data generated by a random sampling, has tended to blind many of us to the virtues of other approaches" (Johannes 1994a).

A new kind of training and research is required to prevent serious overfishing under cooperative management situations. For this purpose Johannes proposed that the less theoretically elegant and less quantitatively rigorous prevention of serious overfishing should be substituted for OSY and MSY as the objective of fisheries management. To implement that, extension workers must learn how to obtain information needed to plan and sustain village management strategies based on the practical aspects of local knowledge. This is not normally part of a fisheries biologist's curriculum, *but it should now be* (*Ibid.*). However, to implement this approach would first demand that the ingrained mentality of fisheries researchers be changed, since biologists are not taught to seek knowledge from people, but first from books and then from nature. It is important to emphasize that Johannes did not regard data-less management as synonymous with "information-less" management; "one doesn't need data to protect a spawning aggregation or a giant clam population that fishermen agree is badly overfished" (Johannes 1994b).

Johannes was concerned that just paying lip-service to TEK had already become important by the 1990s to obtain lucrative consulting and other contracts, which then resulted in volumes of unread reports. He considered it important to publicize how information based on traditional ecological knowledge could be systematically obtained and organized to ensure that it was useful for environmental impact assessment, and that it could be tightly integrated

with information obtained from other sources. He was convinced that local knowledge needs systematic collection, and that this should focus on schools and higher education institutes, using an interdisciplinary approach (Johannes 1984).

Johannes emphasized that research in support of village-based management is also urgently required. Such research requires the interactive and pragmatic testing of various management strategies on the fishing grounds, based on the fishermen's ideas. Subsequent management decisions are then based on the outcomes of those tests. In other words, this is an old trial-and-error management research approach, and it will replace the scientific hypothesis-testing approach to research. Seriously declining fisheries require immediate action, an idea guaranteed to make conventional fisheries biologists hesitant without the huge quantities of data required to fine tune management. There has very been little experimental management research, although there are excellent opportunities for it throughout the Pacific, where village tenured waters are available. The research design could be simple before-closure-and-after surveys, since many of the experiments now being performed by villagers are suitable for this, particularly in Vanuatu and other parts of Melanesia (*Ibid.*).

Johannes reported in detail on a striking renaissance in tradition-based marine resource management in fishing villages in Vanuatu since the early 1990s, which was catalyzed by the Fisheries Department (Johannes 1998a). It provides an excellent example of villagers on their own initiative extending government measures from trochus, for which they were designed, to cover other species of fish and invertebrates. In a follow-up survey of the same villages eight years later, the trend in village-based resource management initiatives was found to have continued, with the number of marine management measures more than doubling in response to continued population growth and commercialization of resources (Johannes and Hickey 2004). The experience of Vanuatu provides many lessons on how to initiate effective and inexpensive government assisted, village-based resources management. It also demonstrates admirably how a local, low-cost, "bottom up" operation that listens to fishermen can have much greater success than an international fisheries project costing tens of millions of dollars.

In one of his last articles Johannes revelled in contrasting his pessimism of a quarter century earlier with the renaissance of community-based marine resource management in parts of Oceania (Johannes 2002). Despite this welcome resurgence, however, he cautioned against complacency. During the intervening years the decline resulting from

the impact of Westernization that he decribed in 1978 had been reversed in many island nations, particularly Vanuatu, Samoa, Cook Islands, Fiji, Palau, Tuvalu, and the State of Hawai'i, USA. Despite the continuation and even intensification of all the conditions that led Johannes 24 years earlier to conclude that the demise of traditional systems was imminent, those traditional management methods are some of the techniques responsible for the renaissance.

Johannes observed that the resurgence of traditional community-based marine resource management can be attributed in large part to a growing perception of resource scarcity, the strengthening of traditional village based authority, to legal recognition of

marine tenure, government support, and improved conservation education, among other things. Although undoubtedly he would be embarassed to read this, many believe that the resurgence of traditional management systems, particularly in the Pacific Islands, owes a great deal to the message, advocacy and tireless efforts of Robert E. Johannes to this most worthwhile of causes, so evocatively first set out in his seminal book, "Words of the Lagoon". His other publications reprinted here emanated from the ideas in that volume. Although traditional knowledge and management are inseperable in his work, his first love is quite evidently local or traditional knowledge and, above all, the fishermen of the Pacific Islands who are its custodians.

Table 1. Main topics of the reprinted publications.

Item	Date	Article title	Main topics addressed
1	1977	Traditional law of the sea in Micronesia	Traditional marine resource management Marine tenure Characteristics of tropical nearshore fisheries Resource scarcity and conservation – Pacific Islanders cf. Westerners Traditional cf. Western legal concepts Failure of Western management Potential usefulness of traditional resource management Consequences of destroying traditional systems
2	1978	Traditional marine conservation methods in Oceania and their demise	Traditional marine resource management Marine tenure Resource scarcity and conservation – Pacific Islanders cf. Westerners Westernization and the decline of traditional systems
3	1978	Reproductive strategies of coastal marine fishes in the tropics.	Reproductive strategies of tropical inshore finfishes Traditional knowledge Scientists and the verification of traditional knowledge
4	1980	Using knowledge of the reproductive behavior of reef and lagoon fishes to improve yields	Relationship between spawning aggregations and fisheries management
5	1981	Working with fishermen to improve coastal tropical fisheries and resource management	Local knowledge reveals "hidden" factors Unappreciated resource areas Categories of local knowledge Traditional conservation practices Cultural acceptability of proposed management Research methods
6	1982	Traditional conservation methods and protected marine areas in Oceania	Local knowledge and MPAs Traditional conservation and ocean reserves Local knowledge as substitute for lack of formally recorded data Local knowledge holders superior to consultants Particular importance of local knowledge of lunar and seasonal cycles and protection of breeding sites
7	1982	Implications of traditional marine resources use for coastal fisheries development in Papua New Guinea	Integrating traditional mechanisms of resource management and conservation in national fisheries policy and development projects Need for better understanding of traditional fishing rights in PNG Cautioned about fisheries development of locally important food items for large-scale external markets

Table 1 (cont'd). Main topics of the reprinted publications.

Item	Date	Article title	Main topics addressed
8	1984	Marine conservation in relation to traditional life-styles of tropical artisanal fishermen	Value of traditional marine conservation measures and local knowledge for marine conservation and natural history studies Need for systematic collection of local knowledge Increased focus on high schools and tertiary education
9	1987	Knowledge possessed by native Australian fishermen could aid seafood technologists	Fatty acids in fish and occlusive vascular disease Incentive to develop fisheries in northern Australia Traditional knowledge of seasonal variation in the fat content
10	1989	Spawning aggregation of the grouper <i>Plectropomus areolatus</i> (Rüppel) in the Solomon Islands	Spawning aggregation of <i>Plectropomus areolatus</i> Fishermens' predictions and author's verification of them
11	1989	Managing small-scale fisheries in Oceania: Unusual constraints and opportunities	Some conditions may preclude economically sound fisheries development Information required for Western-style management often not available Social barriers to capitalistic behavior Occupational pluralism Therefore major role for traditional management and knowledge Poor record of fisheries development projects in the Pacific
12	1990	Fishing and traditional knowledge	Knowledge of spawning aggregations in Palau Example of traditional conservation practises Pacific Islanders centuries ahead of their European counterparts
13	1993	Integrating traditional ecological knowledge and management with environmental impact assessment	Lip-service to importance of TEK Proposed Environmental Impact Assessment based on taxonomic, spatial, temporal and social frames of reference Interdisciplinary teams Determine validity of TEK Ethics of TEK use Proprietary attitude toward TEK
14	1993	The plight of the osfish, or why quantitative sophistication is no substitute for asking the right questions	Failure of statistical analysis and questionnaires Importance of non-random interviews
15	1994	Design of tropical nearshore fisheries extension work beyond the 1990s	Western-style fisheries management worked poorly and even less useful in tropical small-scale inshore fisheries Demands major changes: Training for research and extension Design of fisheries research and extension Prevention of serious overfishing as the objective of management Data-less management Village experiments
16	1994	Co-operative fisheries management: Major changes in training required for government fisheries personnel	Ditto Item 15
17	1994	Pacific Island peoples' science and marine resource management	Anything that contributes to our knowledge of the physical world is part of science Fisheries biologists' attitudes Misappropriation of TEK Need to record knowledge despite risks Romanticising traditional knowledge

18	1998	The case for data-less marine resource management: Examples from tropical nearshore finfisheries	Managing marine fisheries for optimum yields is unattainable Protecting from serious depletion through precautionary management the only practical option Requirements still too data-rich Therefore data-less management required Sampling infeasible Traditional knowledge and management systems should be adopted as the standard practice Requires a major shift in the thinking and training for biological scientists Rewriting textbooks Nothing new about data-less management
19	1998	Government-supported, village-based management of marine resources in Vanuatu	Renaissance in tradition-based marine resource management in Vanuatu Villagers' initiative Low-cost operation succeeds cf expensive international fisheries development project
20	2000	Ignore fishers' knowledge and miss the boat	Five examples (from Solomon Islands, the Canadian Arctic, Alaska and Kiribati) By ignoring fisheries TEK marine researchers and managers may jeopardize fishery resources and their users Types of critical information that fishers can provide TEK not acceptable to biologists
21	2000	I-Kiribati knowledge and management of Tarawa's lagoon resources	Investigation of local knowledge of marine resources in Kiribati Methodology for fieldwork
22	2002	The renaissance of community-based marine resource management in Oceania	Examines the resurgence of traditional community-based marine resource management
23	2003	Fishers' knowledge and management: differing fundamentals in artisanal and industrial fisheries	Tendency not to comprehend differences between tropical small-scale artisanal fisheries and temperate industrial fisheries Partly to blame for misguided development policies and programs for the former Western fisheries textbooks focus on temperate zone fisheries inappropriate for training tropical fisheries managers
24	2003	Use and misuse of traditional ecological knowledge and management practices	Describes nature, origins and value of TEK Examines why some TEK maladaptive Cultural relativism Implications of biologists ignoring TEK Distortion of TEK by advocates and elites The practical value of and ethical issues regarding TEK Traditional management of marine resources Traditional conservation ethic Traditional environmental malpractice

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Secretariat of the Pacific Community, Marine Resources Division, Information Section
BP D5, 98848 Noumea Cedex, New Caledonia
Telephone: +687 262000; Fax: +687 263818; cfpinfo@spc.int; <http://www.spc.int/coastfish>