

Can humans coexist with fishes?

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Gene S. Helfman. 2007. Fish Conservation: A Guide to Understanding and Restoring Global Aquatic Biodiversity and Fishery Resources. Island Press, Washington, DC, USA. \$85.00

Deciding which textbook to assign to students is often a very difficult decision. A textbook should offer more than just a synthesis of information, it should inspire curiosity, cause one to reflect, and provide a framework for making decisions. Most reviews reflect a single opinion, sometimes based on personal preferences. What is missing from most reviews is an assessment of how a book affected students.

We approach this book review differently. We present separate reviews by the instructors and the students participating in a graduate seminar on Fish Conservation. The class format was a mixture of guest lecturers and group discussion. Students were required to write critical comments about each chapter of the book. They understood that they would be co-authors on this review and critical assessment was necessary. The presumption is that similarities between two reviews suggest consensus, but that

differences reflect honest differences of opinion as well as differences in background and experience.

Review by the Instructors

Why did we choose this book as a text? It was recent; it was by Gene Helfman, and we hoped that it would live up to its advanced notices from four noted conservation biologists: Carl Sarafina, Angela Arthington, Peter Moyle and Phil Pister. Full disclosure: Gene Helfman is a personal friend and colleague, so are Peter Moyle and Phil Pister. Gene and Peter are also Advisory Editors of *Environmental Biology of Fishes*, Angela Arthington is a former Advisory Editor. It is a book like no other concerning the management of fishes. It focuses on a central question, “why are the fishes of the world becoming increasingly imperiled, and can we stop this trend”? Yes, there are books about fishes that address some of the same issues, but they are either restricted to a single taxon (e.g., Love et al. 2002) or concentrate on a regional fauna (e.g., Minckley and Deacon 1992). Helfman wants to illuminate the problems fishes face universally. Thus, we chose this text because it was all encompassing of species, ecosystems, and problems associated with fish conservation.

This presents a monumental challenge as one must address the major aquatic systems, how they function, and how anthropogenic influences to those systems disrupt natural processes and affect faunal status. A recounting of these problems leads the reader to the inescapable conclusion that human activities counteract adaptations accrued by fishes over evolutionary time by introducing many novel and intense selective forces. If fishes have been important to humans for sustenance, why have we allowed this to occur? We are all familiar with the concept of the Tragedy of the Commons (Hardin

1968), but the phenomenon of endangerment is worldwide in scope and the abuse of commons is not cross-culturally universal, at least not until recent times. Fishes in some cultures are sacred icons, protected by religious bans and rituals. Why is it that fishery collapses still occur despite our growing proficiency in developing predictive tools? One of Helfman's great accomplishments is to treat these central issues by intermingling ideas of biodiversity, evolutionary processes, cultural values, ethics and epistemology in his exposition. These threads become interwoven at two levels: chapter by chapter and throughout the book culminating in the last two chapters.

Ultimately, all resource management issues come down to value systems. These value systems inform our behaviors and shape the way we perceive, model and interact with natural systems. Like organisms, cultural values can evolve. For aboriginal people the connection to the natural world was direct: fish were wealth. Since the Enlightenment, Western concepts of wealth became more abstract, and socio-economic systems became more sophisticated. Fishes were transformed into commodities, commodities into products, products into money and money became wealth. As a result of this estrangement, humans became estranged from the natural world. It would be trivial if it only resulted in the modern cliché: the modern consumer thinks that the source of food is the supermarket. But anthropocentrism suffuses into many human institutions.

In 1947, human perception of the world's economic system was changed forever when Paul Samuelson published his classical text, *Foundations of Economic Analysis*. The New York Times Obituary (Dec. 14, 2009) section said in tribute to him,

“Mr. Samuelson was credited with transforming his discipline from one that ruminates about economic issues to one that solves

problems, answering questions about cause and effect with mathematical rigor and clarity”.

It is into this cultural milieu that fisheries science was born. The same quote could have been used to describe the influence of two classical texts on fisheries management, Beverton and Holt (1957), and Ricker (1958). This was coalescence of several factors that led to the application of mathematical formalism to both fields; applied statistics had matured as a discipline, game theory was developed, and it was the dawn of the age of computers. The fisheries theory of Maximum Sustainable Yield did bring clarity. It promised that sustainable management could be obtained if we could determine: (a) the size of the harvestable stock, (b) its reproductive capacity, (c) how fishing intensity affects both parameters, and (d) the maximum yield that could be sustained given steady-state conditions. While conceptually appealing, the paradigm of Maximum Sustainable Yield has been a failure (Larkin 1977). It is very difficult to define operationally and its history is very spotty. Several fisheries have been driven to economic extinction and target species left in a perilous state as a result of its application. The MSY (maximum sustainable yield) paradigm offered us accounting precision, but was biologically inaccurate; it is an autecological cartoon. In part, computational and database limitations restricted the ability to incorporate greater biological reality. But, we were held captive by the models themselves. We knew that the models assumed that the environment was at steady state in contradiction to empirical evidence. Moreover advances in fisheries harvest models, tweaked parameters for established variables, rather than satisfying the needs for greater biological understanding.

We were held prisoners by the models because their precision gave us the illusion that both fisheries and economic models were as accurate as those used in engineering. Indeed, when used as a complementary tool in a more holistic framework, some of these models can be useful. For fisheries scientists, and we suspect economists, there is another factor and that is industry pressure, this is a backdrop for explaining why Gene Helfman's book is unique.

Unlike traditional textbooks of fisheries management, Helfman's book reflects the ethical beliefs and values of Conservation Biology. The cultural milieu that galvanized these biologists to form the society was a reaction to the inability of natural resource managers to protect the biota from extinction and ecosystems from dysfunctional decisions. They rejected the assumptions and values of the Progressive-Utilitarian Resource Conservation Ethic, sensu Collicott (1990) in favor of how understanding patterns of biodiversity would lead to a more holistic approach to retaining ecological function and sustaining the biosphere (Meffe 1999). What conservation biologists value most highly was expressed by Aldo Leopold (1946):

“The biotic clock may continue ticking if we:

1. Cease throwing away its parts.
2. Handle it gently.
3. Recognize that its importance transcends economics.
4. Don't let too many people tinker with it.”

According to Collicott and Mumford (1997) this is the foundation for the Evolutionary Ecological Paradigm and encapsulates the core beliefs of conservation biologists. Biodiversity has important intrinsic values. From an aesthetic point of view, it is the expression of many lineages, each species of which is unique. Saving as many

species as possible provides us an opportunity to gain better clues about restoring and sustaining biotic systems. Leopold lacked the analytical tools we use today, but he knew that someone would be able to test his ideas as long as we conserved the biota. For instance, we can test his epigram using a subset of graph theory, Loop Analysis, on many types of communities. Stability results from the exquisite blend of interaction intensity and structural arrangement. The structural arrangement is the key to integrity and at least to the naturalist, the beauty is observing the specificity that allows complex systems to function (e.g., Dambacher et al. 2002), Montaña et al. (2007, 2008), and Hosack et al. (2009).

The values of conservation biologists reconnect man as part of the larger ecosystem. It is a more holistic considering of synecological issues whereas traditional fisheries management is strongly influenced by neoclassic economic concepts. This gives you a better idea of Helfman's point of view. His is a serious endeavor and there is no evidence of the "Age of Aquarius" glibness in his approach. He is not dogmatic about any management philosophy but is pragmatic. He presents classical natural resource problems as case histories, how they arose and the ecological reasons for the problems and then discusses potential solutions. Helfman use quantitative fisheries methods as complementary tools but his decisions are based upon different values than fisheries managers. The value system affects the basis upon which risk is evaluated and the definition of irreversible errors. Some problems result from ignorance, but most arise from economic conflict. For example, Helfman presents the example of the orange roughy (*Hoplostethus atlanticus*); it is harvested in spawning congregations over seamounts. Obviously this greatly affects population resilience and its populations are in

steep decline. The rationale used by the managers is that they will save the species by fishing it to commercial extinction. That is the cost of harvest will exceed the profits of the catch. Obviously this does not factor in the demand side of the equation. The orange roughy is delectable, as it becomes scarce the price point increases. There is motive to fish harder, not less. Not only is this bad biology, but it is bad economic thinking. In this case, the managers have completely adopted the value system of the fishery than the intrinsic value of the fish, itself.

As William Robbins, the environmental historian, concludes (e.g., 1982, 1986, 1994), if you wish to understand natural resource policies, follow the money. There is no ecological necessity for harvesting at MSY; but there is an economic motive to do so. Managers of developing fisheries often exert ever - increasing fishing effort in order to establish the inflection point where catches decline from the peak. The objective is to statistically determine MSY and set limits to fishing intensity. This is called fishing down. There are three reasons why this is a problematic approach: (1) it assumes concavity of the response of the species to harvest effort (few populations clearly show this tendency), (2) one must account for hysteresis effects, and (3) it does not consider how the rest of the food web will respond to changes in population densities of the target species. Fishing down can cause stocks to collapse suddenly and unexpectedly if full faith is put into the models.

How has the Neoclassical Economics Paradigm harmed fishes? First, fishes are viewed as commodities and therefore exchangeable because the value of all commodities is standardized by price points. The politico-economic objective then is concerned with optimizing profit, not necessarily sustaining the resource. When fishes became fungible

within the financial system, cattle and soybeans could be substituted for fishes (i.e., protein substitutes), exchanged for electricity, and fossil fuels (i.e., mortality from dams, oil spills, and stream pollution caused by coal mine tailings).

Externalities or side effects of economic activity on the natural system are not taken into account as costs. Fishing itself has externalities that are finally receiving scientific notice. A major side effect is bycatch. Over 90% of the catch by weight is discarded by shrimpers (FAO). Dolphins, sea turtles, seabirds are among those negatively affected by the fishery itself. In some cases, trawls destroy the benthos and reefs. It's all in Helman's book.

Each species and the biodiversity of different community represent unique evolutionary legacies. Some theologically inclined moral philosophers such as Holmes Rolston (1989) declare it to be sacred, a gift from God. They say defacing nature is a sin (another qualitative value). Others in the Conservation Biology movement assert that native biota and communities have intrinsic values, on scientific grounds (e.g., Soulé 1985; Ehrenfeld 1976; Callicott 1990; Callicott and Mumford 1997; Meffe 1995; Noss and Carpenter 1994; Constanza and Daly 1992; Daly 1995). Callicott and Mumford (1997) call this concern the Evolutionary Ecological Land Ethic. Each species represents a unique product of evolution, thus inherently valuable. Understanding their respective roles within a community reveals how we can manage for a sustainable biosphere. If all species are unique, then by extension many communities are unique, not only in membership but also in functionally. Species are not fungible among different communities that evolved from different origins. That is why species introductions have created such natural disasters and species deletions can cause cascading loss in structure

and function of natural communities. It is why the new economic approach championed by Costanza and Daley (1992) is so important. It implicitly accounts for the goods and services provided by the natural economy and the impacts of human activity upon it. How does neoclassical economic concepts place value on evolutionary processes? It hasn't and perhaps it can't. It has difficulties with valuation of other legacies: value to future generations.

Helfman asserts that the precautionary principle becomes effective when assigning the entity that must bear the burden of proof. Ecological significance should trump statistical significance in deciding whether or not the "no harm-no foul" rule should be enforced. The same mathematical treatment can be used to argue for or against promoting greater standing stocks of fishes. Certain industries such coal mining, natural gas producers, hydropower generators, real estate developers, timber, and petrochemical refineries want to know how much environmental damage will be allowed. They charge regulating agencies with determining the minimum (not optimal) viable population size that is needed so that they can maximize profits. There are models that attempt this, but the true answer is unknowable. There are too many variables to measure, too many parameters to fit, and the interaction of multiple anthropogenic stressors are rarely, if ever considered. The prudent thing to do in the face of uncertainty is to cushion estimates with safety buffers. This is how structural engineers work and this is why the ground fisheries of the northern Gulf of Alaska and Bering Sea have been so successful (Grant Thompson, National Marine Fisheries Service, personal communication). However, there are those who are against buffer because they restrict short-term income. If the burden of proof were placed upon those who stress the system, would the argument be so

protracted? If the punishment were capital punishment for the collapse of the fishery, would there be many risk takers? In some countries architects and engineers faced capital punishment if structural failures resulted in the loss of human lives. This punishment is so severe, that failure is rare. Let us compare this anthropocentric approach to that practiced in aboriginal societies.

Helfman urges us to learn from aboriginal cultures because they value the natural production system and are intimate with it. As an example, this intimacy is embedded in the animist belief of the Mid-Columbia tribes. All natural elements and forces are animated by the same spirit as Man. Therefore all moral rights and obligation that apply to Man must be extended to the entire ecosystem (Hunn 1990). Organisms such as sculpins have intrinsic sacred value. Is this why aboriginal man could sustain fish harvest for 10,000 years in Western North America; whereas Western Culture has nearly exhausted this legacy in just 150? Native Americans had the capability to overfish. The fishing technology of tribal people of the Pacific Northwest was one of the most elaborate, sophisticated and efficient of any non-industrial society (Stewart 1977). The demand for fish and fish products was greater than that of local tribes. Trade routes were extensive. Tribes of the Pacific Northwest coast traded grease rendered from eulachon (*Thaleichthys pacificus*) in exchange for bison (*Bison bison*) and moose (*Alces alces*) hides from the Western Cree and Assiniboine tribes inhabiting an area encompassing the Saskatchewan river, Lake Athabasca, Lake Winnipeg and Hudson Bay (Byram and Lewis 2001). Buffalo and moose hides made good body armor and shields and grease from eulachon was high in calories and did not become rancid quickly. In fact, the trade was so brisk that Robert Rogers, a British governor and Indian agent at a post at the edge

of the western Laurentian Great Lakes notified the British Crown in 1860 about the lucrative possibilities of trading in Ourigan, as the Cree pronounced Ooligan, the word used in Chinook trade jargon for eulachon. Soon European explorers sought to find out where the land of Ourigan was located. This is the story of how Oregon got its name, but also an illustration that religious values may restrict greed and overharvest.

The second reason to consider the wisdom of aboriginal fishers Helfman asserts is that they understand the natural history of their environment. We simply lack information on the basic biology of most fishes and do not fully comprehend their natural history. Helfman believes that some of the information we seek is available but we limit our epistemological perspective. Traditional Ecological Knowledge (TEK) is one of those sources. Ethnobiologists (e.g., ethnobotanists) coined this term. It is a cultural aspect of aboriginal societies who based rules concerning land and resource use from repeated observations through millennia (Berkes et al. 2000). It is experiential, and descriptive, but nonetheless rigorous because observations were numerous; living groups that got it right thrived whereas those that got it wrong did not (Berkes et al. 2000; Ford and Martinez 2000). Large pharmaceutical companies understand that TEK will bring them profits, so they employ ethnobotanists who work with native peoples in order to “discover” plants for medicinal purposes. TEK is more likely to offer better understanding of natural resilience, and therefore restoration principles because rhythms of short and long term cycles of natural disturbances and years of bounty are recorded and incorporated as cultural memory (Berkes et al. 2000, Ford 2000). Critics may underestimate TEK as being meaningful only as a cultural reference to the distant past. However, there is a strong “adaptive management” element to TEK.

We were pleased that the last chapter was devoted to ethics as they provide the basis upon which humans act. Those of us that love fishes may do so for religious reasons (e.g., defending God's creation), esthetic reasons related to physical beauty, interesting behaviors, or because of preserving the adaptive legacy of evolutionary processes is both esthetically pleasing and important for human culture. In some cases, we killed the object of our affections because we loved money more. As in TEK systems, we need to incorporate the ethic that caring for fishes is a sacred responsibility for many reasons including our own survival.

Helfman has produced a book that is highly readable. It is like reading John McPhee. In contrast, most fisheries texts read like Chilton's Manual on repairing the Chevrolet Citation (what a dog that was!). This could have been a difficult book emotionally. It could have been the piscine form of watching the movie *Schindler's List*; you attend because it is good for you. However, like Sebastian Unger's books, (e.g., *The Perfect Storm*) the writing is gripping, although the topic is grim and serious. The literature covered is comprehensive and the logic is clear. Evidence is transformed into arguments and the series of arguments are synthesized at the end of each chapter, often as a series of management recommendations. Helfman presents his opinions forcefully, but also presents contrary views. Given our lack of knowledge, he indicates what information is needed to address a controversial issue. Wherever possible he tries to develop a theoretical perspective on each issue rather than presenting a list of prescriptive actions. The book glows when he discusses fishes from the tropics and coral reefs; it is obvious that these are fishes and systems for which he has great affection. It's all there. Helfman has successfully written a book that is accessible to the interested lay person

while being technically informative to fish wonks. Can we save fishes? Yes we can, but it will take discipline.

Student Reviews:

OVERALL

Overall, this text is well-written, insightful, entertaining, and a valuable addition to a fish enthusiast's library. Some of the figures are of relatively low quality. The broad listing of web sites, grey literature, and scientific publications may provide a bit of something for everyone to take a deeper look into some of these topics. Although topics are, by necessity, raised in multiple chapters, Helfman does a good job of presenting different details on each occasion. As my interests are primarily marine, I gained a lot from the extensive readings on the problems and conservation requirements for freshwater fishes, particularly those residing in rivers. Population declines are rarely the result of a single factor; Helfman delineates major impacts in chapters on direct and indirect causes but maintains continuity and consideration of synergistic effects. The text should be mandatory for fishery biologists.

Overall, Helfman's book represents a good compendium of basic knowledge and information, including an invaluable collection of references, on the topic of fish conservation. However, I feel that this text suffers from an overall lack of organization. Chapter headings and subheadings often seemed to escape the confines of a logical system of organization. Content of the chapters, sections, and subsections regularly drifted away from the topics suggested by the chapter titles, headings, and subheadings under which it was placed. It is understandable that such an ambitious volume covering

such a broad topic as fish conservation is plagued by organizational issues, but it is disappointing that Helfman was unable to overcome them. While this book remains an invaluable resource, and will likely become a classic volume on the topic of human interactions with fishes, its usefulness is limited by an overall lack of cohesion. The human race is too prolific and we are entering a time when we have to be more conscious of our efforts.

The reason I like the personal actions section is because the book concludes with a useful list of ways an individual really can contribute. Often individuals don't realize how powerful they (or small groups) can be. I would have liked to have a short "successes" section within each one of these actions to illustrate how a person or small organization really did make a difference. Real examples are inspiring.

Chapter 1: Fish Biodiversity and Why It Should Matter

In contrast to simply documenting declines, I appreciated that Helfman mentions some of the issues surrounding the question and definition of extinction and sometimes slippery and shifting definition of a species. A broader discussion of IUCN assessment criteria could be justified.

It is a well-written introduction of things to come within the book, giving a glimmer of how bad things really are. Fish facts are written with devastating honesty, letting the truth of the situation speak to the reader's emotional connection with nature's plight. The author is careful not to place blame on one single factor or sector of society.

We are all part of the problem, and we will all need to be a part of the solution to this extinction trend.

Helfman calls conservation scientists to devise restorative practices to help solve some of the problems by understanding interactions and causes. Fish deserve protection for their value as a commodity, their role in ecosystems, their undiscovered values, and their intrinsic value as an amazing evolutionary product. “Inside fragile living things, in little flowers or even in ugly fish, may hidden treasures lie.”

Chapter 2: Roll Call I: A Taxonomic Perspective

Helfman takes a taxonomic approach to describe the status of imperiled fish species and families and identifies the causes of their decline. I found the taxonomic approach to be a successful way to organize the information. This chapter also serves as a quick reference source for information that would otherwise take days to compile for a single family or genera. In addition, the chapter describes the magnitude of fish imperilment that only appears to be getting worse.

This chapter elicited two extreme emotions: amazement and frustration. This chapter reveals the amazing diversity in form and function among fishes and as a result, I disagree to some degree with Helfman’s first line of the conclusion section in which he notes that the chapter has a “decidedly downbeat” tone. For me, frustration resulted from the “depressing redundancy” (p. 48) in the list of insults contributing to fish imperilment. In this chapter, I wondered for the first time whether we will ever learn from the mistakes of those who came before us – and I found myself pondering this question in nearly every subsequent chapter.

Helfman is careful to point out that just because a species is not “listed” does not mean it is in the clear. The rigor and criteria of being listed may not necessarily represent the conditions encountered by marine fishes in peril versus freshwater fishes in peril. Although very few marine fish get the protection of being listed, many have seen dramatic declines in abundance. For example the West coast rockfish, *Sebastes paucispinis* (Boccacio), saw a 97% decline in population from the 1970s to the 1990s.

The imperiled fish listed in IUCN shows that the definition of imperilment is different between nations. The union updates their site annually and setting high standard criteria undermines the usefulness of local and traditional ecological knowledge that is usually common in developing countries that have high biodiversity. Conservation International considers the Philippines one of the world’s biodiversity hotspots that lacks fish lists and needs to be updated.

Chapter 3: Roll Call II: A Geopolitical Perspective

Hopefully with books like this, the sharing of information among people will increase and we can learn from past mistakes. Interdisciplinary action is needed to solve the problems that plague fish today. People from all different backgrounds need to work together and understand one another. The highlight of this chapter is the synthesis of information that will hopefully allow non - science people understand what we know about fish and why they are threatened. Otherwise I do not want to read this chapter in 20 years and have it titled “Fish Obituaries.”

Helfman defines some of the fuzzy words used in science and policy, many of which got these fish into trouble in the first place. Impotent listings, lack of enforcement, and clout of industry over environment are political failings that can be traced back to wiggle words, caveats, and exceptions to the rule. Good intentions, variable results. We are all aware of the problem, but limited resources and economic priorities truncate efforts to solve these fish-related problems. It becomes impossible to convince society that the wellbeing of humans is inextricably tied to the preservation of biodiversity, which very much includes to health of fishes populations.

I think the most valuable message in this chapter is simple: no one country or piece of legislation can solve the problem of biodiversity loss in fishes. I think the increasing number of countries with conservation legislation is cause for hope, but I think Helfman nicely sums up the difficulty with endangered species legislation when he notes that “legislation is no stronger than the ability and willingness of agencies to implement the regulations” (p. 71). I wonder whether laypersons understand the degree to which laws such as the ESA look good on the surface but experience difficulty reaching their stated goals as a result of political and economic pressures.

Chapter 4: Characteristics of Vulnerable Species and Correlates of Imperilment

One shortcoming in this assessment is the distinct differences from freshwater and marine species. Fish utilize different habitats during different stages of life, and their ability to reproduce is especially important. So how can this knowledge be used? It helps those ‘outing’ the imperiled know where to best utilize their time and resources, to make sure

those species in most desperate need are assessed first, before its too little too late (although there is no guarantee that prioritization equals salvation).

Wow, river fishes have it rough. In terms of conservation priorities, it seems clear that endemic species should become the first groups for conservation and assessment. Helfman provides a review of many life history, environmental, and ecological correlates to examine patterns of vulnerability among fishes. The references on marine fishes are fairly good, but I wouldn't have given Roberts and Hawkins top billing there. Work by Jennings et al. provides a better basis than their TREE article. References for risks on protandrous fishes as well as elasmobranchs are available but not mentioned. I thought that his brief discussion section on the fact that many of the imperiled marine fishes undergo direct development was insightful and provides another, often overlooked basis for risk assessment.

Chapter 5: Habitat Modification and Loss

One of the major attributes of this chapter is the proposal of several solutions to habitat modifications and loss. Reestablishment of riparian buffers and designation of sediment standards were two suggestions that could alter the course of habitat degradation. In addition, Helfman examines restoration practices and activities carried out in the United States. These projects have been well intended but primarily unsuccessful in improving fish habitat and preserving fish species. However, they can prove helpful if we learn from past mistakes.

Helfman stresses that what is important to remember is that restoration efforts need to try to achieve something feasible, recognizing the humans will continue to have

effects on the systems and how to mitigate anthropogenic factors is important. It is also important that any efforts be functional correct and not just “look the part”. Conservation efforts need to be continually monitored and improved upon.

Helfman includes an extensive section here on MPAs (Marine Protected Areas). This does not seem like the best place for such a complete discussion of the benefits of MPAs as habitat preservation is only one part of the MPA story. Elimination of harvest seems to me to be the major effect of MPA implementation, and should be discussed in detail in the chapter on overexploitation rather than here in the habitat chapter.

Fisheries represent the most visible and widely discussed impacts on fish populations. Helfman presents the connections between our daily activities and aquatic environments in a clear and concise way throughout this chapter. These impacts are expressed not only in the health of species, but also reproductive and feeding tactics. The solutions to marine fishery habitat degradation (reserves and restoration) are appropriate, but miss an important point. Reduction of overall fishing effort can accomplish the same goal. This approach should not be overlooked. The challenges of restoration and technological fixes to these issues seem to be balanced.

Chapter 6: Dams, Impoundments, and Other Hydrological Alterations

The solution to this problem seems obvious; remove the dams. But it is apparent that dams aren't going anywhere. So the next best solution includes mimicking natural flow variation, installing fish ladders, and restoring channel configuration, to name a few. There are several dams just now installing screens so fish don't swim into the turbines.

Ultimately what will mitigate the impacts of dams is increased appreciation of river systems in their natural state.

Dams in arid landscapes can be particularly problematic as evidenced by the examples of the Salton and Aral Seas. Neither of these examples may be the most appropriate examples of “Dams in the Desert” as neither involved artificial reservoirs created by dams. I wonder why Helfman included them here as subheadings under the “Dams in the Desert” heading.

The statement that “hydropower reservoirs may emit up to 20 times more greenhouse gas than fossil fuel-burning power plants at the same local” (p 139). floored me; I have never heard anything like this. This topic seems highly controversial and I would have liked to have seen a greater discussion of this topic.

Dams have been a major contributing factor to the decline of LRS (Lost River suckers, *Deltistes luxatus*). It is estimated that construction of the Sprague River dam in the Klamath Basin reduced access to 95% of the spawning range of LRS and shortnose suckers, *Chasmistes brevirostris* (USFWS 1993). Other dams in the basin pose fish passage barriers for adults and larval suckers (USFWS 1993).

Chapter 7: Degraded Water Quality

In reading this chapter, I was again struck by the number of times we have been unable to learn from past mistakes, a problem nicely summarized by Helfman in the conclusion by pointing out that “assumptions of minimal effects have proven inaccurate in the past” and yet we continue to make similar assumptions.

Some of these stressors affect individuals and ecosystems for some time. On an individual level physiological responses may linger for days, and chronic stress can stop growth, impair mating, and lower disease resistance. These individuals create stressed populations that disrupt things on an ecosystem level. This reduces the amount of ecosystem services. It costs much less to preserve an intact ecosystem than to manufacture ways to provide those same services. Farmed fish cause undue stress to the environment, with nutrient, chemical, and pathogen pollution being common. Assessment, remediation, and regulation are steps towards finding solutions to the problem of degraded water quality. This starts with a toxicology assessment of water, and potentially bioassessment and biomonitoring metrics to understand the physiochemical conditions. Then stop the pollution at its source and begin restoring the habitat to its natural state. This may require legislation, education, manual removal, etc.

Chapters 8. Alien species I: Case histories, mechanisms and levels; 9. Alien species

I think the case studies are an excellent way to showcase the devastation that can be caused by invasive species. In particular, the Nile perch (*Lates niloticus*) example is excellent as it illustrates the unexpected consequences (deforestation) that can result from invasion. The case studies illustrate again a lack of ability to learn from prior mistakes – how many introductions need to be made before managers realize that introductions are simply not a good idea and are likely to have unintended consequences?

Two chapters on invasive species? The division works, focusing on mechanisms in the first and impacts in the second. If 2/3 of North American extinctions can be linked to introductions the topic may be worthy of a third chapter. Hopefully, this will give

many a cause to examine releasing their ornamental fishes. A useful historical review focused on the U.S. From game fish, canals, and ballast water to surprising bait fishes, the extent of introductions is startling.

Despite LRS (Lost River suckers) tolerance to substandard water quality conditions (Low DO levels, high pH, warm temperatures, un-ionized ammonia concentrations) it has been severely impacted by poor water quality that has caused bacterial infections in LRS and resulted in a number of fish kills (USFWS 1993, Markle and Cooperman 2002)

Chapter 10: Fishes versus Fisheries I: Overfishing

After reading the wonderfully constructed sections on cod, tuna, and sardine-anchovy, and the section on “warning signs ignored” (pg. 294) I realized that if humans were to go extinct tomorrow and the only records of human civilization were catch records and fisheries reports, any other intelligent form of life would think our species incapable of either assimilating information or learning anything. I particularly like Box 10.3 because I think many people think that generating fishery statistics just “can’t be that difficult”. As one layperson asked me at a boat show, “what’s so hard about making everyone count the fish they catch?”

There is a massive data deficiency when it comes to stingrays and their kin. This group is as vulnerable as sharks, but has received less publicity. It is difficult to be resilient to fishing pressure with such low fecundities and long life spans. A mention of stingrays would be useful in this text. I can’t believe that the Pelagic Shark Research Foundation is mentioned in this section. It is good that inspired citizenry can contribute

to conservation issues, but this organization may cause more problems than it helps to solve. The group has been sued by the National Marine Sanctuary, illegally purchased white sharks, and sued over authorship in scientific publications. It is uniformed and self-serving. They protest the addition of white sharks into the Monterey Bay aquarium, but disregard the role of other species.

Chapter 11: Fishes versus Fisheries II: Behavior, Life History Evolution, and Ecosystems.

An underlying theme to the whole books is that fisheries management is about managing people not fishes. Helfman brings up a key idea related to managing people for improved fisheries: “ the informed consumer.” Many times people or not well informed as to where their food is coming from, or whether or not it is a harvested in a sustainable manner. In my lifetime, I now see labels on seafood, but many times it is hard to know which area harvests organisms in a sustainable way. There are little cards passed out that review some areas and stocks that are sustainable. If people are given a choice as to which food they should eat hopefully they will choose a product that is harvested in a sustainable way, yet knowing where ones food comes from is hard to know. I would encourage this factor to help connect the public with the environment.

Perhaps, it’s my background in population ecology that fogs my vision. His promotion of behavioral studies in this section is warranted but not worthy of the foremost placement he has given it. Yes, the more we know, the better off we are. Behavioral studies are time consuming and extremely difficult to do correctly in the concealing medium of an aquatic environment. Several of the behavioral examples he

provided are aspects that emerge after extensive fishing on the population. Very little is known about most fished species, rapid assessments and population-based studies provide the best approach for conservation in a data poor situation. This section would benefit from briefly discussing the impact of our vast lack of knowledge on exploited populations. Fishing effort is well ahead of biological knowledge. My personal opinion is that behavioral studies can help fine tune management approaches, but in many situations we need to act quickly. Understanding life history and habitat use should be the first steps. Having ranted briefly, this section is an excellent discussion of fishery impacts. Fishing as an evolutionary agent has only recently been demonstrated even though the basis of production-based single species fisheries management is predicated on this to a large extent. The complexities of this impact are well presented for a broad audience. Fished populations are usually used as separate entities. The connections that Helfman provides among species, population, assemblages, communities, and ecosystems are extremely valuable. Fishing can change not just abundance, but shift community composition. The inset on dolphin and tuna is a great, and often overlooked, feature for general audiences. Setting for tuna on schools of dolphin increased dolphin mortality but setting based on other features (logs or other features) resulted in much greater bycatch and mortality of other fish species. Viewing fisheries in an “eco-system based” context is the popular mantra. Indeed, past practices have been overly narrow and too destructive. How ecosystem complexities should be considered is overriding the simple fact that fishes need to be viewed in an ecological context. If applying the term “eco-system based” approach will do this, so be it. A fundamental change in management approaches

is a social issue. Decreased fishing effort and less destructive harvest methods are necessities.

Chapter 12: Coral Reefs, Fishes, and Fisheries: Exploitation in Fragile Ecosystems

In his discussion of whether coral reef ecosystems are demographically and/or ecologically “open” vs. “closed” and how this dichotomy relates to fisheries management Helfman did not successfully link the dichotomy. I was left thinking, “so what?” at the end of this section.

Since coral reefs are closed systems they must be managed as such, unfortunately this means that many exploitive practices that do not replace extracted resources need to be at a minimum. It is clear that reefs can support relatively large densities of people (p 355) because their communities viewed reefs as their lifeblood. The community recognized that the reef was vital to their prolonged survival, thus they took it upon themselves to find the right ways to conserve and were willing to follow the rules set up.

Mangroves as being nursery grounds for coral reef species are also been exploited almost incessantly. Mangroves are being converted into shrimp and milkfish ponds, harvested for lumber and charcoal. In the Philippines, 90% of the mangrove areas were destroyed by 1984. The government since then has been doing its best effort to rehabilitate destroyed mangroves and declaring remaining mangroves for protection. Projects promoting community-based approaches to coastal resource management and direct partnership with the stakeholders in the sustainable development and management of mangroves, seagrass beds, coral reefs and other coastal resources were also launched.

Ecotourism is an alternative way of protecting the mangroves and other coastal resources. Some protected mangroves in the Philippines are being developed as tourist destinations, adding small zoos and Aquamarine Park where people can see different forms of wildlife and marine species. This approach also provides employment to local people.

Chapter 14: The Promise of Aquaculture and Hatcheries

I am pleased to see that a full chapter was dedicated to issues surrounding the trade in live fishes. Removal of individuals as well as impacts to the environment were carefully considered. Active live fish fisheries can be found in California and Oregon for local markets. His presentation of the economic extent and impact overlooks the expansion of these fisheries outside of Asia. His discussion of the ecological issues focuses primarily on the overfishing of predator species, aggregation overfishing, and bycatch. I think this misses the point. My understanding of this fishery is that the objective is to provide generally plate-sized fishes to restaurants and select vendors. Sometimes these would be platter-sized, sure, but the overall effort is directed at smaller fishes. Rarely can adult grouper be accommodated in such settings or would these fit on a platter. In many cases, the live fish fishery is beneficial because it tends to target smaller, often juvenile fishes which can withstand greater levels of fishing pressure than say, larger, older individuals. This isn't always the case, and so, the impact of the live fish fishery is best considered on a species-by-species or life history case.

Given the contentious nature of this topic, I thought Helfman treated the hatchery chapter as objectively as one could expect. His point early in the chapter that "pressure

on aquatic resources and wild fish stocks can only increase as the human population grows” (pg. 407) is not debatable and he sets up the chapter nicely by asking in what way human needs for fish protein will be met. I think the section on “the new alchemy” is very important because I think people don’t realize how inefficient culturing some fishes is in terms of energy expenditure and feed.

Given the increasing pressure on fish populations, aquaculture could be heralded as a key direction. Helfman does not present aquaculture as a solution in previous chapters and outlines the pros and cons of this practice for farming and stocking of fishes including the genetic consequences of escape and chemical pollution of waterways by aquaculture facilities. Helfman presents a clear argument that if stocking cannot be relied on as the sole or even primary means of augmenting population declines.

Chapter 15: The Ethics of Exploitation and Intervention: Do We Have the Right?

Helfman’s objectives for the chapter were to provide information to make ethical decisions regarding fish, and to provoke thought. He accomplished both. He addressed issue of pain perception in fish and the ethics of sportfishing, electrofishing, and potentially harmful research. The ethics for me is not rooted in the presence of pain or lack thereof. It is simpler, do no harm unless it is absolutely necessary. However, I must admit that the lines do get blurred, especially because I do enjoy fishing.

Yet, early on in his chapter he admits to fishing and conducting practices that could be considered unethical. I find this chapter full of hypocrisy by Helfman about his action and what he proclaims “we must do” and this bothers me. Is he saying he is a bad person, is he saying it is ok that he did these things?

As painful as it is to actually thinking about ethics, I applaud Helfman's inclusion of this chapter. I think this is a difficult issue that people do not care to wrestle with and I really had to think about whether I have considered ethical issues carefully enough in my research and as an angler. His treatment of this topic is exceptionally even-handed and the strength in the equality with which each "side" of the issue is presented is that the reader is forced to come to his or her own conclusion rather than to simply rely on the conclusion of the author; this requires the reader to actually think about the issue.

Although this is a subject many scientists choose to avoid, it is an important subject for individuals and society to consider. In my experience, I have found the unethical treatment towards fish to be the practice rather than the exception (e.g. holding fish out of the water to take a picture for 5 minutes, playing fish, over harvest. A number of ethical issues arise with the LRS (Lost River suckers) issue. Perhaps the largest issue concerning LRS is the ethics of driving a fish to extinction for economic gain. This issue could be approached from a number of different angles, especially if your part of the Klamath Basin agriculture community trying to support your family. Judging from the recent progress in resolving the land and water conflicts in the Klamath Basin, it appears that society has decided they have an ethical obligation to LRS and are willing to make sacrifices to conserve it.

Chapter 16: Future Perspectives: Beyond Gloom and Doom?

In this chapter, Helfman attempts to raise the hopes and spirits of the reader after 15 chapters of depressing accounts of worldwide fish imperilment due to the actions of humans. Although Helfman offers solutions in each chapter, he takes a closer look at the

many solutions available to mitigate or even reverse this decline. He also provides a personal look at how he deals with the sad state of fish conservation and the struggle to remain positive and optimistic.

Helfman's statement that humans should behave more like predatory fishes is shrewd and encompasses much of the management perspectives that are presented in this chapter: ecosystem-based, precautionary, reserves (as we don't use the Nile perch as our example). Harvesting smaller fishes, switching targets when natural abundances decline, and allowing a proportion of prey species to remain for reproduction and other predators goes a long way toward sustainable use of marine fishes. This reaches back to comments from other chapters that remind, "It is right to act and manage with natural selection in mind". Fishing-induced evolutionary changes have been increasingly discovered among heavily exploited populations. It further contrasts technological approaches that rely on hatcheries or similar methods (think large-scale iron fertilization) to "solve" current dilemmas. The section on personal actions is a valuable addition to the chapter and book.

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