THE SPOT PRAWN FISHERY
A STATUS REPORT

EXECUTIVE SUMMARY

Cristina L. Mormorunni
A Project of the Asia Pacific Environmental Exchange
December 2001

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INTRODUCTION

Who is the Asia Pacific Environmental Exchange?

The Asia Pacific Environmental Exchange (APEX) was founded in 1997 to promote innovative and collaborative strategies for advancing sustainable environmental policies and natural resource management systems. APEX's guiding mission is to apply the theory and principles of Ecological Economics[1] and Ecosystem Health[2] to environmental policy. APEX's marine campaigns serve to concretize these theories and demonstrate how economic health and environmental sustainability can be mutually reinforcing.

APEX's Marine Program — The Spot Prawn Project

The Spot Prawn Project is the platform on which APEX intends to build its Marine Programs. This project will allow APEX to apply its vision, academic base, and cooperative campaign strategies to the marine environment, establishing a unique niche in the marine conservation community. The Project's multiple and far-reaching benefits will extend to the marine environment and fishing communities, and will influence existing systems of fisheries management.

The two cutting-edge disciplines of Ecological Economics and Ecosystem Health will be used to shift the spot prawn fishery toward long-term ecological, economic, and sociocultural sustainability. This is critical. Although there are myriad international and national laws and management systems established to protect our oceans, fishery collapse and habitat destruction continue. New and innovative approaches are needed.

The Spot Prawn Project has the potential to protect more than just spot prawns. Its goals and strategies are aimed at providing a concrete vision for marine sustainability and fisheries conservation that is influential and meaningful for managers, fishers, and the general public.

The Status Report — What is it? What is it not?

The Spot Prawn Fishery: A Status Report is based on the first-ever review of the fishery. The *Report* includes basic information about spot prawn biology and ecology, the nature of the various fisheries, the range of management systems, landings, markets, and product types, and future management issues or concerns. The *Status Report* is not the definitive document on spot prawns and their management, but a starting point that can be used as common ground for future discussions about spot prawn management. The *Status Report* is a living document—one that will continue to be revised and added to.

Why Spot Prawns?

Despite broad recognition of the many threats to marine sustainability, our management systems and combination of laws and regulations have largely failed to conserve fisheries and protect the intimate connection between the economy and the ecosystem evident in marine-dependent communities. It is widely recognized that shrimp, harvested in the wild or produced via aquaculture, are among the most destructive and unsustainable fisheries worldwide. The spot prawn fishery carries the potential to be the exception to the unsustainability that typifies other shrimp fisheries.

AN OVERVIEW OF SPOT PRAWN ECOLOGY

The spot prawn (*Pandalus platyceros*) is the largest of the pandalid shrimp. Its geographic range extends from Southern California to Alaska's Aleutian Islands, around to the Sea of Japan and the Korea Strait. (There is some anecdotal infor-

1 The field of *Ecological Economics* "is not a single, new paradigm based in shared assumptions and theory" (Costanza et. al. 1997, p. 50). Ecological Economics is deliberately transdisciplinary or pluralistic and works from the initial premise that the "earth has a limited capacity for sustainably supporting people and their artifacts determined by combinations of resource limits and ecological thresholds" (Costanza et al. 1997, p. 75). Human economic systems are seen as a subset of, and entirely dependent on, natural ecosystems. "Ecological economists are rethinking both ecology and economics to better understand the nature of biodiversity, and arguing from biological theory how natural and social systems have co-evolved together such that neither can be understood apart from the other" (Costanza et al. 1997, p. 50). Elements of both ecology and economics and the links that exist between them, such as resource economics and ecology and environmental impact assessment, are relied on in assessing and directing development projects and resource management.

2 The academic discipline of *Ecosystem Health* holds that the *health* of an ecosystem is determined by four major characteristics: *sustainability, activity, organization,* and *resilience.* "An ecological system is healthy and free from 'distress syndrome' (irreversible process of system breakdown leading to collapse) if it is stable and sustainable—that is, if it is active and maintains its organization and autonomy over time and is resilient to stress" (Costanza et al. 1992, p. 9). According to the practitioners of ecosystem health, this definition can and should be applied to all complex systems, and takes into account the fact that ecosystems will grow and evolve in response to both the natural and cultural environments within which they are rooted.

mation that suggests a spot prawn fishery may also extend across the California border into Baja California, Mexico.) Spot prawns tend to inhabit rocky or hard bottoms that include glass-sponge reefs, coral beds, and the edges of marine canyons, but the animals are not simply distributed in the most commonly available habitat type. Spot prawn distribution tends to be patchy; the factors determining the size and location of these patches is unclear, yet is probably a function of active habitat selection and larval transport. Spot prawns may be vulnerable to local overfishing and serial depletion due to this patchy distribution.

The spot prawn is a protandric hermaphrodite; i.e., it first matures as a male, then mates, then enters a transition phase during which its sexual characteristics become female. The spot prawn generally reaches sexual maturity by its third year, and by the fourth year most males begin changing sex. This biological characteristic of the spot prawn, coupled with the fact that the fishery tends to target the larger, older, more fecund animals, may make the fishery vulnerable to overfishing.

AN OVERVIEW OF SPOT PRAWN MANAGEMENT

The spot prawn fishery spans an enormous and diverse stretch of ecosystems and management jurisdictions. While there are inherent similarities in both the ecological and management systems throughout the animal's range, there are numerous differences. The table below is an effort to summarize the nature of the fishery and the management systems in place in each of the five juris-

An Overview of Management

	Alaska	British Columbia	Washington	Oregon	California
Years in the Fishery	±30	±87	±60	±8	±31
Total Catch (lbs/1999)*	800,000	3.1 million	228,375	22,221	615,000
Pot/Trap Catch	800,000	3.1 million	127,049*	752	201,096
Trawl Catch	N/A	N/A	96,250	21,459	413,658
Pot Only Fishery	YES	YES	YES (inshore)	NO	NO
Total Catch Limits	YES	NO	YES	NO	NO
Daily Catch Limits	NO	YES∞	YES (non-Tribal)	NO	NO
Number of Vessels	310^	257¥	26Δ (non-Tribal)	16µ	97
Limits on Entry	YES	YES	YES (non-Tribal)	YES	NO≠
Seasonal Closures	YES	YES	YES	NO	YES
Area Closures	YES	YES	YES	NO	YES‡
Daylight-Only Fishing	YES	YES	YES (inshore)	NO	NO
Size Limits	YES	YES	YES (inshore)	NO	NO
Trawl-Excluder Device	N/A	N/A	YES	YES	YES
Trawl-Mesh Restrictions	N/A	N/A	YES	YES	YES
Pot/Trap Limits	YES	YES	YES	YES	YES
Pot Destruct Device	YES	YES	YES	NO	YES
Fish Tickets/Logs	YES	YES	YES	YES	YES
Observer Coverage	YES#	YES	NO	NO	NO@
CPUE Data	YES	YES	YES	NO	YES
Stock Assessment	NO	NO	NO	NO	NO
Surveys	YES	YES	YES	NO	NO
Spawner Index	NO	YES	NO	NO	NO
Management Plan	YES	YES	YES (inshore)	NO	NO

* Excluding Hood Canal tribal catch.

∞ Only the recreational fishery is subject to daily catch limits.

^ 310 permits are allowed in the fishery. In 1999, 183 permits were fished. In the 2000–1 season, 168 permits registered to fish.

¥ There are 253 commercial licenses and 4 communal (Aboriginal) licenses in the fishery. Not all licenses are fished in a given year.

Δ This is an estimate of vessels in the inshore and offshore fishery. The inshore fishery (non-Tribal) is limited to 18 licenses. The offshore fishery (non-Tribal) is limited to 15 licenses: 10 pot and 5 trawl.

µ Total of 6 trawl permits and 10 trap permits are allowed in the fishery.

≠ A Restricted Access Program is presently being developed for the trap fishery.

‡ There are no trap area closures at the present time.

\# Observer coverage is required only on floating processors. The owner pays for observer coverage.

@ An observer program was instituted in 2000. Coverage is 2% of the trap fleet and 2% of the trawl fleet.

dictions. It sets the stage for the more detailed discussions that follow.

THE ALASKA SPOT PRAWN FISHERY

Southeastern Alaska's spot prawn fishery is the last significant shrimp pot fishery in the state. The fishery is primarily a small-boat fishery that includes gillnetters, trollers, and limit seiners. Catcher-processors are participating in the fishery in growing numbers. This is a source of some management concern, due to the fact that these vessels remain on the fishing grounds until their holds are full, which complicates the timely collection of harvest data.

Alaska sets Guideline Harvest Levels (GHL) in each fishing district. The Alaska Department of Fish and Game's (ADF&G) emergency order process is used to close fishing districts as GHLs are approached. If a district(s) is closed prematurely, additional emergency orders are issued and the district(s) is reopened to fishing until the full GHL is harvested. Catch-per-unit-effort (CPUE) data seem to indicate that catch is stable or declining. However, the number of actively fished permits appears to be increasing. The GHLs in the 2000–2001 season were harvested in less than a month in most of the 16 fishing areas, and in one week or less in certain districts. A limited-entry program has been implemented in order to control effort and overcapitalization.

The Southeastern Alaska Pot Shrimp Management Plan was adopted in January 2000 and mandates that spot prawns are managed on a "sustained yield" basis. To this end, ADF&G continues to develop and expand its shrimp management and research program. Management data are acquired through fish ticket data, limited pre- and post-season surveys, and on-board and dockside catch sampling programs. ADF&G is increasing the amount of on-board sampling that takes place during the fishing season, and expanding the areas sampled.

ADF&G's management and conservation concerns fall into two broad categories: overfishing and overcapitalization. The risk of overfishing stems from the following factors:

- GHLs are not based on current estimates of population abundance
- size-specific harvesting; i.e., the retention of the larger and more valuable (in both economic and biological terms) females
- potential for serial stock depletion

The potential overcapitalization of the fishery arises from the following factors:

- increasing number of permits fished
- increasing number of catcher-processors participating in the fishery
- increasing intensity and efficiency of the fishery

According to ADF&G, a conservative and more informed management strategy is being developed and implemented in the southeastern Alaska spot prawn fishery. Precaution is at the core of this system. Research is needed to define the physical, chemical, biological, and temporal trends that influence and affect fisheries production. This process will require time, money, and dedication. One of the central management challenges, then, is the establishment of an adaptive research and management system that can accurately predict future production, given ever-changing population dynamics and demographics, and can also rapidly detect and prevent localized depletion. In addition, better abundance-related management practices are being developed to maintain sustainable catches.

THE BRITISH COLUMBIA SPOT PRAWN FISHERY

Fisheries and Oceans Canada believes that British Columbia's (BC's) inshore prawn stocks are fully exploited, but the species' actual abundance and distribution are unknown. The fishery is presently managed to meet two biological objectives: 1) prevention of growth overfishing, and 2) prevention of recruitment overfishing. Growth overfishing is controlled through legal size limits, trap-escapement modifications, and the timing of season openings. Recruitment overfishing has been managed since 1979 through the implementation and refinement of what is known as a fixed escapement, or spawner index system.

The underlying principle of this system is that the fishery is closed to fishing once the number of females caught per trap reaches a minimum monthly spawner index or threshold (MMI). The system is implemented through in-season monitoring that takes place on the fishing grounds. The mean index of spawner abundance in the samples is compared to the MMI. Closures are implemented in a given area when the sample average of females per trap is less than or equal to the MMI. Once a closure is instituted, it stays in place until the season opens the following year.

According to Fisheries and Oceans, spot prawn management in Canada is a "work in progress." The goal of BC's management system is to continue improving the state of biological and ecological knowledge and integrating this information into management and regulatory systems. Management assumptions are constantly challenged and tested. Driving the evolution and future of BC's system is the desire to move toward ecosystem management, developing regimes that operate on a very fine scale and are adaptive and able to respond quickly to changing environmental or human conditions.

Challenges facing the BC system are limited ecological information and the lack of the funds needed to obtain it. The exponential rise in the recreational fishing effort poses a risk of severe overfishing. The development and implementation of a management strategy that addresses the recreational fishery's impact on the species and on conservation is imperative. Similarly, the increased efficiency and intensity of the commercial sector must continue to be regulated and controlled. Finally, all efforts must be made to control illegal spot prawn sales, particularly when the illegal activity is concentrated in areas that are closed to fishing for ecological or conservation reasons.

THE WASHINGTON SPOT PRAWN FISHERY

The biological status of spot prawns in Washington is virtually unknown. There is no information regarding the size, genetic structure, number, or location of different stocks. The nature of the stock-recruitment relationship is also unknown, and it is unclear whether larvae are transported from one area to another or whether an area provides its own recruitment.

Spot prawns are found in both offshore (coastal) and inshore (Puget Sound and Northern Straits of San Juan de Fuca) waters, and commercial fisheries exist in both areas. Significant spot prawn fisheries have existed since at least the 1940s. The locus of activity in the offshore fishery is in the heads of Grays, Quinalt, and Juan de Fuca canyons. The inshore fishery takes place in the Hood Canal, the Whidbey Island Basin, the San Juan Islands, Discovery Bay, and Port Angeles Harbor.

Since the 1994 Rafeedie Decision, Washington State Tribes and the Washington Department of Fish and Wildlife (WDFW) have shared responsibility for spot prawn management, with a goal of ensuring that harvest guidelines are allocated equitably between Tribal and non-Tribal fishers. Due to the fact that there is "little scientific basis for setting quotas," WDFW has expressed a commitment to pursuing as precautionary an approach as possible, until the biological and fishery performance data are obtained and analyzed. Of particular concern to both WDFW and fishers is the risk of overharvest due to the small, localized distribution of spot prawns.

The offshore fishery is currently managed under the Emerging Commercial Fisheries Act (ECFA), which is used to protect the stock in the face of rapid commercial expansion and capitalization. This regulatory system, set in place in 1999, limits catch and participation in the fishery and institutes management measures that regulate the "time, place, and manner in which fishing is conducted". The fisheries will be managed under the auspices of the ECFA until 2004. A management plan to control effort and conserve the stocks will be presented to the Legislature prior to 2004, when the ECFA regulations are scheduled to expire.

The inshore commercial fishery is managed according to *The Puget Sound (excluding Hood Canal) Pandalid Shrimp Harvest Management Plan*. The *Management Plan* is developed annually and governs the management of non-Tribal and Tribal spot prawn fisheries in order "to preserve, protect, and perpetuate Puget Sound pandalid shrimp resources; provide for their sustainable harvest; protect the habitat necessary to sustain these harvests; and minimize bycatch mortalities of other species". The Hood Canal fishery has been closed to State commercial fisheries since 1992. The fishery is still open to recreational fishing and Hood Canal Treaty Tribes. It is managed under the *2001 Hood Canal Shrimp Harvest Management Plan between the Point No Point Treaty Tribes and the State of Washington.*

According to managers, the state of knowledge is seen as the biggest challenge to the long-term sustainability of the fishery. In data-limited situations such as that which currently exists in Washington, it is difficult to determine and establish biological or management reference points. In addition, the lifecycle characteristics of spot prawns and the fact that the fishery relies heavily on females also potentially puts the fishery at risk. It is believed that if recruitment and stock size prove to be link-

ed, then removing a large proportion of females may reduce the number of young prawns entering the population and, ultimately, the robustness and resiliency of the population. Nevertheless, managers think the commercial fishery appears sustainable at the present time. Fishing effort is regulated and controlled; expansion is slow. Admittedly, the future is a "wild card"; acquiring a greater ecological understanding of spot prawns and their environment is imperative.

THE OREGON SPOT PRAWN FISHERY

Biological knowledge regarding the status of the Oregon spot prawn population is limited. The species abundance and distribution information that does exist seems to suggest that sparse populations of prawns are widely distributed along the Oregon coast. There have been no scientific surveys dedicated to spot prawns, and most of the information regarding the status of the species is based on fishers' local ecological knowledge or has been extrapolated from the fisheries in other regions.

Spot prawns are managed under the Oregon Department of Fish and Wildlife's (ODFW) Developmental Fisheries Program and can be fished year-round with trawls or pots. The Oregon Legislature created the Developmental Fisheries Program in 1993 to institute a management system for developmental fishery resources that addresses both long-term commercial and biological values, and protects the long-term sustainability of those resources through planned commercial development, where appropriate.

ODFW is concerned that the limited nature of critical spot prawn habitat in Oregon threatens the long-term conservation of the stocks and may not be ecologically compatible with trawling. Due to the spot prawn's finite biological potential and limited distribution, localized depletions are likely, and the population is at risk due to overfishing.

According to ODFW, the long-term sustainability of the fishery will require that basic biological and ecological information is acquired and reflected in management and regulatory systems. The Department has identified the following areas for further inquiry:

- acquire the scientific information needed to determine the biological status, distribution, and life history of spot prawns
- develop an understanding of the effects of fishing on marine habitats and ecosystems and other species
- improve fishing practices and equipment to protect the ocean resources, particularly by:
    - identifying and protecting critical marine habitat and other important biological habitats for spot prawns
    - identifying juvenile, spawning, and rearing areas

THE CALIFORNIA SPOT PRAWN FISHERY

Exploratory biological surveys carried out by the California Department of Fish and Game (CDFG) in the 1960s revealed the presence of spot prawns coast-wide. Estimates of population size were not made at that time. Additional surveys carried out in the 1980s focused on species distribution and range. Today the locus of spot prawns' geographic range is believed to be in the Santa Barbara Channel and at the head of submarine canyons such as Monterey Canyon, its tributary Carmel Canyon, and the canyons of the Southern California Bight. Spot prawns are also associated with ocean features such as offshore banks and ridges, and islands such as the Channel Islands.

Few data are presently available regarding the status of the stock, and CDFG does not have the resources to conduct biological surveys at this time. CPUE and total catch are considered by managers to be the best available indicators of resource status; these appear to be sustainable.

The California spot prawn fishery has a long history, originating in the 1930s, when Monterey Bay fishers started landing spot prawns incidentally caught in octopus traps. The fishery did not develop into a commercial-scale fishery until the 1970s and now consists of four principal geographical components: northern trawl, northern trap, southern trawl, and southern trap. In the 1999 season, the trawl fleet caught 68% of landings; traps caught 32%.

The fishery is managed through a series of increasingly restrictive regulations. Due to the fact that there are no stock assessments for the spot prawn resource, the development of management and regulatory systems has been grounded in landing trends and CPUE data. Consultations with fishers have also informed the existing management regime. The capitalization and effort in the fishery have increased rap-

idly in the last 10 years. Growing market demand for prawns, in combination with a growing number of displaced fishers due to the overfishing and collapse of other fisheries, guarantees that capitalization and effort will not taper off in the near future. To ensure long-term sustainability, CDFG has recommended the following measures be considered:

- limited entry for both the trap and trawl fleets
- development of a coast-wide spot prawn GIS database, which would identify historic and current fishing areas as well as preferred habitats
- coast-wide, fisheries-independent population survey of spot prawn resource
- evaluation of the effectiveness of the current management scheme

Presently, the spot prawn fishery is open access for both trap and trawl. A restricted-access program for the trap fishery will be implemented by April 2002. In addition, the California Fish and Game Commission approved the development of an observer program for the fishery. By late 2000, 21 trap vessels and 21 trawl vessels were participating in the program. To date, the CDFG has gathered data from approximately 80 spot prawn trawl tows and about 200 trap strings. Due to the sensitivity of the bycatch issue, CDFG will keep the data from this program confidential until a larger sample size is available.

RECOMMENDATIONS

Approach of the Recommendations

The disciplines of Ecological Economics and Ecosystem Health are indispensable tools for achieving the long-term sustainability of the spot prawn fishery. APEX's recommendations for the spot prawn fishery are set in the context of these disciplines. The discussion is divided into four problem areas: *ecological sustainability and appropriate scale* for the fishery, *fair distribution* of fishing privileges and benefits, *democratic* regulation and management, and *economic efficiency*.

Ecological Sustainability and Scale of the Fishery

To ensure the long-term productive potential of a fishery, the ecological sustainability and ecosystem health of the entire ecosystem must be maintained and prioritized over the short-term economic potential of, say, a particular fishing season. This is justified even when using strictly economic considerations. The vast majority of economic benefits from a fishery are held in the future, and cannot be harvested without protecting ecosystem health and developing sustainable management systems.

Fisheries can be harvested unsustainably or sustainably. They can be thought of as a stock of short-term benefits or as a potentially infinite flow of benefits. If, in the name of maximizing profits or the bottom line, we harvest too many fish or destroy critical marine ecosystems, we prevent the potentially permanent, sustainable flow of marine benefits that in the end provides society with the greatest return. Human activities in the spot prawn ecosystem must be regulated so as not to destroy the ecosystem on which spot prawns depend. The fishery should be managed to ensure the sustainability not only of a single species, but also of the system as a whole. To this end, a "sea ethic" should be adopted and integrated into decision-making systems as a guiding principle.

The fact that humans are land-dwelling creatures means that our ethical systems have co-evolved with our relationship to the land, and are thus more advanced than our relationship and system of marine values. It is time that we extend our ethical tendrils beyond the high-tide mark. A "sea ethic" would allow society to extend its sense of community responsibility beyond the needs of humanity to encompass the whole, living seascape. Fostering a "sea ethic" in spot prawn management would require that the ecological footprint of the fishery be continually minimized.

Manage According to the Precautionary Approach

The limited ecological information about the spot prawn fishery and its ecosystem increases the risk of fishery or ecosystem collapse. Avoidance of the vast and often irreversible costs of collapse requires a precautionary approach to spot prawn management. Precautionary management does not mean a zero-risk management approach; rather, it is a directive to proceed with caution. The level of precaution applied is a function of the amount of information available; precaution increases as the amount of knowledge decreases. Precautionary management of spot prawns is essential for the following reasons:

- life-history characteristics, such as low fecundity
- the lack of basic ecological information in most areas
- the susceptibility of the species to recruitment overfishing because the catch includes the

"entire female size range and the largest males"
- the "hierarchical spatial structure of shellfish stocks" (Orensanz et al. 1998)

Ensure the Adequacy of Environmental Information

It is a prerequisite of sustainable spot prawn management that adequate ecological information is collected and integrated into manage-ment and regulatory systems. The lack of knowledge about spot prawns and their role in the marine ecosystem is a serious risk. Adequate, quality ecological information is the cornerstone of sustainable management. Without the collection and effective utilization of this type of information, important ecological and economic assets like the spot prawn fishery will not be managed sustainably. The costs will be borne by the environment and the industries and communities that depend on the fishery.

Reduce the Environmental Impacts of Fishing to the Lowest Possible Level

THE PROBLEM WITH BYCATCH

It is important that the level of spot prawn bycatch in the fishery and in other fisheries is established, especially with regard to the incidental catch and mortality of juvenile spot prawns. The bycatch of at-risk species, like certain rockfish species, may speed up the rate of fisheries collapse and/or prevent the recovery of depleted species or stocks. As long as precise, per-species bycatch levels remain unquantifiable, reliable sustainable harvest levels can not be established and estimates of stock size and recruitment will be inaccurate.

PROMOTING SELECTIVE GEAR — PHASING OUT TRAWLING

The promotion of selective gear—gear that minimizes the waste of target species and minimizes the bycatch of non-target species—is an internationally recognized imperative for sustainable fisheries. Only a small percentage of overall effort in the spot prawn fishery is trawl effort. Bans on spot prawn trawling are in place for ecological reasons in Alaska, British Columbia, and Washington's inshore fishery (a phase-out plan is being developed for the coastal fishery). Many of the managers and scientists interviewed for the *Status Report* questioned whether, given spot prawn biology, a trawl fishery was even "appropriate."

Spot prawn trawl gear is non-selective and destructive—an important ecological consideration, given the sensitivity of the spot prawn habitat and associated species; e.g., bocaccio. Fishing for spot prawns with traps or pots is more likely to result in an ecologically sound and economically viable fishery for spot prawns and for ecologically interrelated species such as rockfish.

Management should be Systemic and Spatial in Orientation

A sustainable spot prawn fishery will require the development of management systems that are spatially oriented and systemic in focus. Precautionary management is multidimensional and places an emphasis on spatial stock structure and the processes or factors that influence it. A very fine spatial-management scale is essential due to the patchiness of spot prawn distribution, as well as to overcome the vulnerability of these patches to depletion. In addition, an iterative and adaptive management approach should be developed that is able to rapidly respond to localized declines, shifts in environmental conditions, or changes in the capitalization and effort of the fleet.

DEVELOP A NETWORK OF MARINE PROTECTED AREAS

Marine protected areas or reserves are spatially determined management tools that are potentially important elements in the precautionary-management toolbox. Marine reserves benefit fish, fishers, and the marine environment, and are effective as proactive or reactive management tools. Spot prawns' patchy distribution and vulnerability to serial depletion make marine reserves or a reserve network a vital management tool. The closure of some areas to fishing would protect the stocks in those areas, possibly provide a recruitment source for other regions, and protect critical spot prawn habitat. Spot-prawn drift across reserve boundaries could serve as a potential source for augmenting local catch. Effective marine protected area design will require that spot prawn movement and habitat requirements for all essential life stages are well understood. The areas set aside should be monitored pre- and post-reserve designation so that the effectiveness of the marine protected area can be established and the need for changes or adaptations determined.

Fair Distribution — Democracy in Regulation and Management

Achieving a fair distribution of fishing privileges and benefits is essential to ensuring sustainable management systems. Were there no limit to the spot prawn population, accomplishing fair distri-

bution and a democratic management system would be easy. However, spot prawns, like all fisheries, do have clear biological limits. Recognition of these limits must be reflected in distribution and management regimes. A failure to limit the privilege or capacity to fish will result in overfishing, ecological collapse, and market failure. The market cannot detect the ecological limits of the fishery, which is why we need regulation.

There are lots of different ways in which fair distribution and democratic management can be achieved. Ultimately, the best system is one that reflects and grows out of the context—economic, social, and ecological—within which a given fishery is rooted. In order for fair distribution and democracy to be attained in the spot prawn fishery's regulation and management, the following should be considered:

Control Overcapitalization
Systems to better control and manage overcapitalization and fishing effort should be instituted in all regions and should be applied to both commercial and recreational fisheries. These systems should strive to be equitable so that benefits and costs are distributed as equitably as possible across fishery participants.

Create a System of Economic Incentives
Economic incentive systems play an important role in fair distribution and the development of democratic and efficient management. Incentive-based instruments are a fundamental component of sustainable management because they have the capacity to correct or prevent the type of market failures that often compromise the long-term viability of fisheries. Economic incentives can be used to: ensure that externalities are properly accounted for; overcome the "tragedy of the commons" by assisting in the equitable delineation of property rights; correct myopic time discounting; manage under conditions of uncertainty or incomplete information.

Foster Collaboration and Cooperation in Decision-Making and Management
Collaborative or cooperative natural resource management is an idea that has gained considerable currency in recent years. Cooperative management is grounded in a belief that management will be more effective and ultimately sustainable if all those with an interest in the resource participate in the development and implementation of natural resource management policy. The equitable and legitimate participation in decision-making and management ensures that individual or community commitment and belief in the given resource management policies and systems is increased and enhanced. The incentive shifts from maximizing individual gains to maximizing communal returns. The accepted time scale for returns lengthens and fosters a greater recognition of the links between ecological systems and economic systems.

The structure of the regime, and the nature and degree to which management responsibilities are evenly shared between players, are contextual. The dynamics and characteristics of an effective community-based system necessarily reflect the ecological, social, political, cultural, and economic conditions on which it is based.

Economic Efficiency

The market should operate freely within the ecological boundaries and regulated distribution of fishing privileges, as long as the producers and purchasers of spot prawns capture the full costs and benefits. One way of overcoming economic and market inefficiencies is the development of economic incentive systems. In addition, assistance should be provided to fishers to continually increase the quality and value of their catches. One aspect of accomplishing this would be to pursue Marine Stewardship Council (MSC) certification and the MSC eco-label for all or part of the fishery.

The MSC voluntary certification program allows an independent certifier to evaluate a given fishery against an environmental standard that takes into account the biological status of the fish population or stock, the effects of fishing on the environment, and existing management systems. If the fishery meets the standard, the MSC eco-label is awarded and the fishery designated "a well-managed and sustainable fishery." The eco-label allows consumers concerned about the sustainability of their seafood to choose seafood that is the "Best Environmental Choice in Seafood." A recent US survey found that 70% of the people surveyed would prefer to purchase seafood that was determined to come from a sustainable source.

WHERE TO FROM HERE

The spot prawn fishery has great potential to be an exception to the ecological and social destruction that typifies other shrimp fisheries. APEX's Spot

Prawn Project will apply the principles of Ecological Economics and Ecosystem Health to the marine environment for the first time. A path for shifting the fishery toward long-term ecological, economic, and sociocultural sustainability will be delineated in this manner.

The Spot Prawn Fishery: A Status Report details the state of ecological knowledge and the range and diversity of existing science and management systems, and outlines a series of recommendations aimed at charting a more sustainable course for the fishery. The *Status Report* is the first review of its kind. It is a work in progress and will therefore require improvement and revision. Although APEX plans to update it in the next 12 to 18 months, it currently serves as an effective platform for collaborative discussion of the changes necessary to guarantee the sustainability of the spot prawn fishery.

APEX hopes to obtain comments and criticisms from as wide a range of interests as possible. We expect that this information will be obtained through informal discussions and meetings. In addition, APEX will host a series of more formal meetings. First, we plan to organize a gathering at which scientists and managers can come together to share information, management strategies, and possibly a vision for the future. This will be followed by a series of regional workshops where all interested parties can roll up their sleeves and start the hard work of moving past rhetoric to begin co-creating a sustainable future for the spot prawn fishery.