ANNEX I

SEA TURTLES CONSERVATION: International Agreements

Fish and Fishing, Maritime affairs, 16USC 1537 note

SEC. 609. (a) The Secretary of State, in consultation with the Secretary of Commerce, shall, with respect to those species of sea turtles the conservation of which is the subject of regulations promulgated by the Secretary of Commerce on June 29, 1987:

(1) initiate negotiations as soon as possible for the development of bilateral or multilateral agreements with other nations for the protection and conservation of such species of sea turtles;
(2) initiate negotiations as soon as possible with all foreign governments which are engaged in, or which have persons or companies engaged in, commercial fishing operations which, as determined by the Secretary of Commerce, may affect adversely such species of sea turtles, for the purpose of entering into bilateral and multilateral treaties with such countries to protect such species of sea turtles;
(3) encourage such other agreements to promote the purposes of this section with other nations for the protection of specific ocean and land regions which are of special significance to the health and stability of such species of sea turtles;
(4) initiate the amendment of any existing international treaty for the protection and conservation of such species of sea turtles to which the United States is a party in order to make such treaty consistent with the purposes and policies of this section; and
(5) provide to the Congress by not later than one year after the date of enactment of this section:

(A) a list of each nation which conducts commercial shrimp fishing operations within the geographic range of distribution of such sea turtles;
(B) a list of each nation which conducts commercial shrimp fishing operations which may affect adversely such species of sea turtles; and
(C) a full report on:

(i) the results of his efforts under this section; and
(ii) the status of measures taken by each nation listed pursuant to paragraph (A) or (B) to protect and conserve such sea turtles.

SEC. 609. (b)(1) IN GENERAL. The importation of shrimp or products from shrimp which have been harvested with commercial fishing technology which may affect adversely such species of sea turtles shall be prohibited not later than May 1, 1991, except as provided in paragraph (2).

SEC. 609. (b)(2) CERTIFICATION PROCEDURE. The ban on importation of shrimp or products from shrimp pursuant to paragraph (1) shall not apply if the President shall determine and certify to the Congress not later than May 1, 1991, and annually thereafter that:

(A) the government of the harvesting nation has provided documentary evidence of the adoption of a regulatory program governing the incidental taking of such sea turtles in the course of such harvesting that is comparable to that of the United States; and
(B) the average rate of that incidental taking by the vessels of the harvesting nation is comparable to the average rate of incidental taking of sea turtles by United States vessels in the course of such harvesting; or
(C) the particular fishing environment of the harvesting nation does not pose a threat of the incidental taking of such sea turtles in the course of such harvesting.

ANNEX II

Appendix 1

THE ISSUE OF BYCATCH IN MODERN FISHERIES, WITH SPECIAL REFERENCE TO SHRIMP TRAWLS

By Dr. J. Frazier

Definition of "Bycatch":

1. The term "bycatch" has been used in different ways, and there may be some confusion over its meaning. When applied to contemporary fisheries, the word refers to animals (and plants to a much lesser extent) which are caught incidental to attempts to catch a "target species".

2. A prime example of bycatch comes from the shrimp/prawn trawl, a type of gear which is dragged along the sea bottom to catch shrimps and prawns; on retrieving the trawl nets, the catch typically includes not just shrimp and prawns, but other organisms which were in the way of the nets as they were trawled. Dividing the catch into target species (shrimp and prawns) and bycatch (animals other than shrimp and prawns), there is sometimes a ratio of 1 to 10 or even 1 to 20, indicating that for every kilogram of shrimp, 10 or 20 kilograms of other animals were extracted from the sea. Sea turtles, when caught in shrimp trawls, form part of the bycatch.

3. The present dispute before the Panel is a bycatch issue: marine turtles caught in shrimp trawls constitute an important component of the bycatch of shrimp trawling. Indeed, the problem of sea turtles drowning in shrimp trawls is the classical "tip of the bycatch iceberg".

Fate of Bycatch:

4. Once they have been caught and landed, the animals in the bycatch can be utilized, thus, becoming a "byproduct" of the fishing operation. Alternatively, organisms in the bycatch can be discarded, and thrown back into the sea as "discards".

Global Relevance of Bycatch:

5. A recent report by the United Nations Food and Agriculture Organization (FAO) estimates that the annual bycatch in world fisheries totals 29 million metric tons; of this, an estimated 27 million metric tons are discarded. Shrimp trawling - notably shrimp trawling in the tropics - accounts for some 35 per cent of the total world bycatch (Alverson et. al., 1994). To put these numbers in perspective, according to the FAO, the annual total for marine fisheries landings during recent years has been between 80 and 90 million metric tons. In other words, annual discards are equivalent to about a third of the total annual catch that is brought to port.

Status of Knowledge on Bycatch:

6. Despite the obvious importance - economic, environmental and social - of bycatch in contemporary fisheries, it is a subject which is little understood and poorly documented. Various recent publications, especially by fisheries experts at the FAO, make it clear that there is a general lack of systematic - and reliable - information on the problem of bycatch, or bycatch utilization (e.g., Andrew and Pepperell, 1992; Everett, 1995:280; Teutscher, 1995a:4; 1995b:16; Eyabi-Eyabi,

1995:19; FAO, 1997a:3-7; Clucas, 1997a:8; Everett, 1997:46; 55; Prado, 1997:42). Likewise, there is a general lack of awareness of the magnitude and gravity of the problem (Everett, 1997:55), and this involves policy makers in various regions, including Southeast and South Asia (Prado and Rahman, 1995:24-25). Although there are very few systematic studies on the levels of mortality due to bycatch, it is widely accepted that this is a major source of fisheries mortality. Hence, experts in the evaluation of global bycatch have summarized the dilemma: "[Fisheries] Management for the better part of this century has operated largely in ignorance of many of the mortality coefficients". (Alverson and Hughes, 1995:17).

Reactions by Fishers and the Fishing Industry to Bycatch:

7. When confronted with bycatch, there are several ways in which fishers can respond. The issue may be ignored, and the unwanted animals and plants may simply be discarded and thrown back into the sea. Shrimp fisheries target one of the most commercially lucrative of all fisheries products - shrimp, so the operation is focused on catching, handling, sorting, conserving, storing, transporting, and marketing shrimp. "Typically, if the bycatch from shrimp trawling has any value at all, it can be twenty or thirty times less valuable than the shrimp" (Clucas, 1997c:6); hence, there is often no, or insufficient, economic incentive to deal bycatch, and it is simply discarded. "Various studies on fishery bycatch have made it clear that discarding is pervasive in world fisheries ..." (Alverson and Hughes, 1995:26).

8. Alternately, the fishers may look for a way of using the bycatch, or a part of it. Thus, the bycatch is separated into "other food fish" and "trash fish". The ways in which these components are dealt with is then determined by market prices and/or regulations.

9. Finally, attempts can be made to avoid the bycatch. This may involve modifying the gear so that it does not capture the "non-target" species (for example, by altering the dimensions or other characteristics of nets, using excluder devices, etc.). It is also possible to change the way, place and time that fishing is carried out; for example, fishing can be banned from an area, either on a long term or a seasonal basis.

10. If endangered species are part of the bycatch, other factors come to bear. "The incidental capture of prohibited or endangered species as bycatch is potentially a very serious problem for the future of the fisheries." (Prado, 1997:25). "Avoidance of by-catch through selective trawl designs is considered a high priority in many fisheries, particularly where the incidental capture of turtles is controversial". (Andrew and Pepperell, 1992:527). Hence, when endangered species are involved, solutions to bycatch problems normally involve reglamentation by governing authorities, as dictated by society (see Hall, 1995).

Implications of Discarding, or "Wastage":

11. Despite its pervasive nature, there are few detailed scientific studies of the effects of discarding, or wastage of bycatch; and although little is known about the proportion of discards that die, bycatch mortality is regarded to be high (except in certain resistant species, such as crabs). At an ecological level, even less is known about what happens when large numbers of dead and mauled marine animals are thrown, en masse, back into the sea. It has been argued that the biotic composition of the area changes, not only from the mortality caused by fishing but from the introduction of large quantities of dead animals. Physical and chemical characteristics of the sea floor may also be affected, particularly if discarding is done in shallow waters (Harris and Poiner, 1990).

12. Because of a lack of basic information, there are no simple scientific pronouncements about the impacts of discarding. However, in terms of social and economic considerations, many societies

do not accept the present degree of wastage in modern fisheries, and have called upon their governments to find solutions to this practice (e.g., Alverson and Hughes, 1995:13; Dilday, 1995; Everett, 1995; Olsen, 1995; Clucas, 1997c:47-49). The number of international accords, as well as statements from concerned citizens, which focus on this issue is large and growing (see sections below on International Accords Regarding Bycatch and International Concern Over the State of the Oceans, Bycatch and Sea Turtles).

13. In relation to the five countries directly involved in the present dispute, a recent report by the FAO indicates that 90 per cent of the bycatch is discarded in India, Malaysia, Pakistan and the United States, while 50 per cent is discarded in Thailand (Teutscher, 1995b: Table 6).

Implications of Utilization of Bycatch:

14. Over the last few years, technologies have been developed to utilize fishes which were formerly regarded as "trash fish" (Clucas, 1997c:32). Indeed, as world fisheries production reached a plateau - despite tremendous advances in technology and capital investment in modern vessels, gear and advanced electronics, competition for fisheries resources became "increasingly acute" (Alverson and Hughes, 1995:14), and as a result, there were countless initiatives to utilize more of what was caught during fishing operations. For example, in 1981 the FAO together with the International Development Research Centre sponsored an international technical consultation "Fish By-Catch ... Bonus from the Sea", which resulted in a 163-page proceedings of technical information and recommendations on exploiting more bycatch (IDRC, 1982).

15. There are numerous "success stories" of technological advancements and consequent increases in utilization of bycatch. The marketing and consumption of what were considered to be "trash fish" in Southeast Asia, using technologies promoted by the Southeast Asian Fisheries Development Center, in Bangkok (SEAFDEC), is a clear example (Clucas, 1997a:12). It has been reported that, in some instances, very little of the bycatch from the Thai shrimp fishery is now discarded at sea (Kungsuwan, 1996), and recent descriptions of the fishes utilized from trawling activities in both Thailand and Malaysia indicate that they are removing virtually everything which gets into the nets (Chee, 1997; Clucas, 1997c:32-33).

16. Clearly, utilization of bycatch - and avoiding the tremendous wastage involved in discards - is now a major priority in fishery policy around the world (Teutscher, 1995a), yet, there are many diverse issues which complicate the implementation of policies to reduce discards. Ironically, one of the factors which favors more efficient bycatch utilization is the demise of inshore fisheries (Bostock and Ryder, 1995:47). Clucas (1997b:65) identified this phenomenon in the trawl fishery for finfish in Malaysia: "As 'traditional' food fish sources become increasingly under pressure because of scarcity of stock and growing human populations more unusual species will be taken into the [human] food chain and change from being discarded bycatch to incidental catch". In those cases where effective at-sea bycatch collection procedures have developed, there has regularly been a decrease in inshore harvests, frequently related to conflicts with mechanized trawlers. Two clear examples are India (Bostock and Ryder, 1995:47) and Gambia (Jallow, 1995:32). Other prime examples of this phenomenon are Cameroon (Eyabi-Eyabi, 1995:22) and Mozambique (Kelleher and Mussa, 1995:66), where artisanal fisheries are no longer lucrative, and the fishers have turned to collecting bycatch from shrimp trawlers.

17. In other words, in these cases of "efficient bycatch utilization" what were once self-sufficient inshore fishers, have now been reduced to the role of bycatch collectors, dependent on discards, or low-value sales, of what are regarded as "trash fish" from other fisheries. As the phenomenon takes place within national borders, it is seen as progress and efficiency: if the producers of bycatch were

instead from one nation and the artisanal fishermen, converted to "trash fish" collectors, were from another nation, the relationship would be perceived in totally different light, and with considerable alarm.

18. Another question that needs to be considered is just what the bycatch is used for. For example, during the 1990's in Thailand, the bycatch which has been used "has usually ended up at fishmeal factories…as an important ingredient for animal feed" (Kungsuwan, 1995:87-88). At the same time, a significant (but unknown) part of the utilized bycatch in Viet Nam is used for animal food or as fertilizer for agriculture (Tuoc, 1995:97). Nearly 85 per cent of the utilized bycatch in Cuba is destined for animal feed (García-Rodríguez, 1995:25). This pattern is repeated on a world level, and it estimated that a third of the production from modern fisheries is destined for use as fishmeal or other secondary products. As a matter of course, this involves the export of fishmeal and oil from the "Third World" to be used as animal feed and fertilizer in the "First World". Needless to say, many people concerned with food security in the poorer countries are deeply alarmed by this mercantile arrangement of "the poor feeding the rich" (e.g., Kent, 1980; 1983; 1984; 1985; 1986; 1987; 1989; 1994; McGoodwin, 1990). This is to say nothing of ecological and social costs of processing and transporting animal protein to be used as animal feeds (e.g., Folke and Kautsky, 1989; Barraclough and Finger-Stich, 1995).

19. At one level, the extensive utilization of bycatch could be used to argue that fishing is more efficient, because there are fewer discards. However, both the ecological and the sociological consequences of this form of intensive exploitation are likely to be disastrous. Indeed, publications representing the small-scale fisheries (which constitutes the vast majority of the world's fishers), leave little doubt about the problems generated by trawling activities and near complete utilization of their bycatch, particularly in Southeast Asia (e.g., Pauly, 1988; 1995; Pauly and Neal, 1985; Pauly and Chua, 1988; Mathew, 1990).

20. Pronouncements of the FAO, based on regional fisheries meetings, make this point very clear: "It was recognized however that there are particular problems associated with the use of shrimp bycatch. The catch consists of a large number of small fish of many species, which are being caught at maturity or as juveniles, which makes conventional methods of utilization problematical." (FAO, 1997a:11). "It should be noted that the fuller utilization of incidental catches and the consequent decline in discards does not necessarily indicate an improvement in fisheries conservation of the ecological impact of the fishery. In some cases this may lead to increased pressure on some stocks of species and to increases in unidentified species mixes in reported landings" (FAO, 1997a:12). Clucas (1997c:47) discusses several critical points relevant to this issue, showing that much more is involved in conserving marine resources than just utilizing everything that is caught.

21. "The expert consultations leading up to the adoption of the Code of Conduct for Responsible Fisheries gave definitive priority status to the avoidance of fish that might be subsequently discarded and only as the last resort to marketing and utilisation issues. The rational behind this was that little is known about the effects of removal of the discards on the ecosystem and if a market is generated it is going to be difficult to reverse the situation." (see FAO, 1994).

Implications of Taking Bycatch:

22. Independently of whether or not bycatch is utilized, or discarded, the simple act of taking it has both ecological and social implications. Even critiques from a strictly economic stand point, have conceded that lessening incidental capture reduces costs to those fishers who depend on the species taken as bycatch in other fisheries, and this "benefits the traditional harvesters". (Smith, 1995).

23. The ecological impacts of taking bycatch are not well understood, but are usually thought to be substantial (Andrew and Pepperell, 1992). "If large quantities of bycatch are taken important parts of the marine ecosystem may be affected. If the taking of bycatch removes a fish habitat such as corals, sponges and seaweed, this may also affect fish populations". (Prado, 1997:41).

24. Many authors have explained that the gravity of the bycatch problem is a symptom of the contemporary dilemma with overfishing (e.g., Romine, 1995): "One of the major contributing factors to the significance of the bycatch problem is systematic overfishing" (Murawski, 1995:7); "The easiest solution to discard problems involving overexploited species may be a reduction in fishing effort". (Alverson and Hughes, 1995:27). "The single action that will provide the greatest improvement to the bycatch and discard problem in certain fisheries is the reduction of these effort levels. Without such control, other solutions to the bycatch and discard problem will be less effective, and real success in efforts to better manage the ocean's resources will be more difficult to attain". (Everett, 1995:280).

25. The importance of reducing bycatch and minimizing ecological impacts from fishing operations have been emphasized by a long list of people, in diverse occasions and in diverse fora (e.g., Andrew and Pepperell, 1992; Alverson et al., 1994; R. Bin Ali, 1995b; R. Alverson, 1995; Alverson and Hughes, 1995; Dilday, 1995; Fairley, 1995; FAO, 1995; 1997a; Laist, 1995; Murawski, 1995; Olsen, 1995; Prado and Rahman, 1995; 1996; Romine, 1995; Kungsuwan, 1996; Everett, 1997; Norse, 1997a; Prado, 1997).

26. This has led to the conclusion that managing fisheries, protecting marine organisms and ecosystems cannot be done by just considering one species at a time, out of context with other species and the marine environment: "The commonly referred to 'ecosystem approach' to fishery management is now necessitating that research extends beyond the emphasis on target species and single species approaches to stock assessment, and that rather more emphasis be given to determine optimal relationships among populations in the same ecosystem". (Everett, 1997:47). Species that are components of bycatch, need to be managed and conserved by resolving the bycatch problem, together with other more conventional conservation activities.

Avoidance and Exclusion of Bycatch:

27. The reduction of bycatch has been given priority status by various specialists and agencies, both national and international. In the parlance of fisheries biology and management, this means using fishing gear and techniques which are more "selective", and today this is one of the great challenges before modern fisheries (see, for example, Andrew and Pepperell, 1992; FAO, 1994; 1995; 1997a; Fairley, 1995; Prado and Rahman, 1995; 1996; Wray, 1995; Clucas, 1997c).

28. Aside from the technological and scientific challenges, there are other basic matters that must be resolved. For example, during the FAO/INFOFISH/SEAFDEC Workshop on Research in Selectivity of Fishing Gear and Methods in South East Asia and Selective Shrimp Fishing, fisheries experts from Southeast and South Asia observed that "in general, research in fishing technology, including fishing gear selectivity, was not given priority". With special reference to shrimp fisheries, they recommended that: there should be modifications to some gear to reduce bycatch; traditional fishing methods should be studied to improve resource conservation; and "state authorities should implement suggestions made by the researchers" (Prado and Rahman, 1995:24-25). (As usual, people with technical expertise provide basic information, but are rarely part of the decision making process for national policy, so it is not surprising to see the level of frustration expressed in this last statement. This situation is seen by the fact that numerous biologists, conservationists and fisheries officers - many of them from the countries involved in the present dispute - have for decades been trying to and

promote more selective fishing and the use of TEDs, often with negligible results at the policy making level - see Annex II).

29. One of the most succinct summaries of the discussion on bycatch comes from two, forward-looking members of the fishing industry: "The merits of a fisherman can no longer be measured solely by how much he catches, but also on what he does not". (Paine and Gruver, 1995).

Environmental Impacts of Bottom Trawling:

30. For more than 600 years, bottom trawling has been claimed to be deleterious to fishers and fisheries, but there have been few systematic studies on this complex issue (McGoodwin, 1990). "As an efficient but unselective fishing method, this [bottom trawling] has led to the capture of numerous small sized species as well as juveniles of the larger species taken by other fishery sectors". "Many bycatch species are exploited at a small size and the yield of the resource could increase if [they could be] exploited at a larger species size which may also increase the landed value". (FAO, 1997a:7).

31. One of the earliest signs of effects of trawling is changes in the species composition and/or size composition of the organisms captured in the nets. Sainsbury (1987; 1989), working in Northwestern Australia, reported that as a trawl fishery developed in time, the occurrence of sponges and other emergent organisms that anchor to the sea floor decreased. At the same time, those species of fishes which associate with dense emergent organisms also declined in abundance. Routinely, as in Sainsbury's study, the fishes which decrease in numbers are of commercial value.

32. Nichols (1989) showed that with increased shrimp trawling in the Gulf of Mexico, some species of fishes dropped dramatically in abundance; Atlantic croaker, for example, dropped to 20 per cent of what they were in the 1970s. Furthermore, mean weight per individual for these species followed the same sharp decline, and instead of being composed of several age classes, by the mid 1980s the catch was mainly first year fish. These are both clear signs of intensified mortality - in this case attributed to bycatch problems.

33. There are few systematic studies of the effects of trawling, especially in tropical fisheries stocks, but where there is information, it shows that fishes preferred for food by people decrease, while fishes not normally consumed increase. Chan and Liew (1986) did a detailed study off the coast of Terengganu, Malaysia, comparing the fishes caught in trawls with what was known of the fish fauna 18 years before trawling was introduced. They found that fishes of the family Leiognathidae (food fishes), dropped from 12.79 per cent to 2.70 per cent of the biomass. In addition, their analysis of the trophic structure of the fish assemblages sampled indicated that they were relatively simple; this may also be an effect of the ecological impacts of 18 years of bottom trawling. Pauly and Neal (1985) reported similar changes in fish assemblages after shrimp trawling in other areas of Southeast Asia.

34. To a great extent, these ecological changes are attributed to mortality of bycatch. However, there are other, less evident but pernicious effects of bottom trawling. Norse (1997a) reported on the results of an international workshop on bottom trawling, in which it was concluded that this form of fishing "is the most important source of human-caused physical disturbance on the world's continental shelves". The participants determined that this disturbance results, among other things, in the crushing of marine animals and their habitats, greatly reducing the complexity of the sea floor; furthermore, trawling can cause major changes in biogeochemistry, water clarity, and other abiotic features. The reduction in biological and textural diversity is a major deterrent in the survival and recruitment of countless marine organisms, including many species that are commercially important.

35. Of those detailed investigations on the physical effects of bottom trawling, that reported by Auster et. al. (1996) is most remarkable. These authors explained that although it is widely known that the use of "mobile fishing gear" (which includes bottom trawls and dredges) alters sea floor habitats, few studies have attempted to quantify these effects. They used a remotely operated vehicle (ROV) to obtain video images of the sea bed in the Gulf of Maine. Indices of bottom cover were calculated for transects inside an area that had been closed to mobile fishing gear for 10 years, as well as for other transects just outside the closed area. In addition, they compared images of a second area taken before trawling occurred there, and then six years later after the bottom had been exposed to trawling. The evidence clearly shows, both visually and statistically, that these gear greatly reduce the diversity of organisms living on the sea bed, as well as the textural complexity of the bottom. The authors explained how deterioration in sea floor complexity directly affects the survival of juvenile target species and hence, productivity from the fisheries point of view. Thus, effects of fishing gear must be evaluated not simply in terms of the removal of target and non-target species, but also taking into account other impacts on the environment.

36. Although there is a clear need for systematic studies comparing trawled and un-trawled sea bottoms, Auster et. al., (1996:197) argue that in some fishing grounds "no sufficiently large areas exist that can act as true non-impacted reference sites". Concluding that habitat-based management should take into account the impacts of mobile fishing gear, they explain: "Clearly, mobile gear provide efficient ways to harvest living marine resources in the short-term, but economic efficiency may have an ecological price that requires restriction of the activity in select areas".

The Relevance of Shrimp Trawling to Bycatch Problems:

37. Of the various types of bottom trawling, shrimp trawling is one of the best known. This is not only because of the high monetary value of the target species - shrimp and prawns - but also because of the relatively high environmental impact of shrimp trawling, as indicated especially by the amount of bycatch and discards that it produces. Shrimp fisheries are estimated to contribute some 1.8 million tons of landed catch, or about 2.3 per cent of the total of annual marine catch. At the same time, it has been estimated that shrimp fisheries produce 9.5 million tons of discards, or 35 per cent of the annual world total (Alverson et al., 1994; Teutscher, 1995b:11; Clucas, 1997a:7). Hence, 2.3 per cent of total marine production results in 35 per cent of the total discards. (Since nearly half the weight of a shrimp is "head", and this part of the animal is usually discarded before consumption, if shrimp with "heads" were included in the calculations for landed catch, the contribution of food for human consumption will be considerably less than indicated by the above figures.)

38. Considering the way in which shrimp trawlers operate, it is not difficult to understand why they produce so much bycatch. Take for example a typical "twin trawler" from Malaysia (R. Bin Ali, 1995b). It is equipped with two trawl nets, each about 13 meters wide. If the boat steams at 1.25 knots while trawling, and one trawling session lasts for 3 hours, during one trawl (also called "tow" or "drag") the boat would advance nearly 7 km. With both nets open, the total width covered would be about 26 meters, giving an area of 175,500 square meters of sea floor that would be dragged during one trawl. With an average of 4 trawls a day and 20 days a month of active fishing, one single shrimp trawler would scrape and drag 168 square kilometers of sea floor in a year. (Ali [1997:5] reported trawling speeds of 2.5 to 3.0 knots and nets that were 18.0 and 23.9 m wide; using these higher values, the calculated area covered would be 744 square kilometers per year per boat.) When thousands of such trawlers are operating, the area impacted is enormous.

39. In shrimp trawl fisheries the catch is separated into shrimp and prawns (the "target species") and bycatch; the latter can be proportioned into: "food fish" and "trash fish". "Food fish" are usually sold directly for human consumption, either fresh or preserved, for example by salting and drying.

Those fishes separated as "trash fish" have no conventional market for human food, so their commercial value is low or non existent. When they are utilized, "trash fish" species are normally processed into a secondary product, such as fishmeal or fish oil, and then employed in animal foods or agricultural fertilizers. Since the monetary value of bycatch can be less than a twentieth that of bycatch (Clucas, 1997c:6), there is often little economic incentive for marketing non-target species.

40. The proportion of "trash fish" in the catch varies depending on place, time, fishery and other factors. For example, a recent report from the Department of Fisheries, Thailand (Kungsuwan, 1996: Tables 3 and 4) shows that 75 per cent of the production from all fishing activities in the Gulf of Thailand (excluding shrimp culture) was "true trash fish", while in the Andaman Sea 76 per cent was "true trash fish". As usual, the proportion of "trash fish" produced from shrimp trawling is much higher than for the other fisheries. In the Gulf of Thailand, 82 per cent of the catch from shrimp trawling was "true trash fish", while in the Andaman Sea the "true trash fish" component was 85 per cent of the catch of shrimp trawlers.

41. Of the different types of shrimp fisheries, it is the industrialized tropical fishery that is most typically characterized as highly destructive to marine resources, with relatively high levels of discards (e.g., Andrew and Pepperell, 1992; Teutscher, 1995b:12; Clucas, 1997a:7). This has been documented in many nations (Alverson et. al., 1994), including: Cameroon (Eyabi-Eyabi, 1995:20); India (Bostock and Ryder, 1995:41 ff.); Malaysia (R. Bin Ali, 1995b); Nigeria (Akande and Tobor, 1995:72); Suriname (Lieveld, 1995: Tables 1, 4 and 5); Tanzania (Mgawe, 1995:81); and Thailand (Kungsuwan, 1995:87-88);

42. A comparison between two Asian fisheries may help illuminate the gravity of the problem. Annual discards from just the fleet based at Vishakapatnam (East coast of India) are estimated to be between 99,000 and 130,000 metric tons (Gordon, 1990). A number of explanations have been offered for the fact that so much bycatch is discarded, in a land where food, especially protein, is needed by so many people; the main reasons point to the fact that there is little financial incentive to sort, store, transport, handle, and sell most types of bycatch (Bostock and Ryder, 1995:43-45). Yet, it is remarkable that in India, where costs of labor are remarkably low, there is little financial incentive to market bycatch, while in Thailand and Malaysia, where operational costs are considerably higher, a much greater proportion, or virtually all, bycatch is utilized. Two questions arise: Is the efficiency of handling and marketing low value bycatch that much greater in Southeast Asia, despite higher labor and operating costs? or, Is fisheries production from Southeast Asia meager in relation to the Bay of Bengal, resulting in bycatch which would not normally be economically viable, being attractive for a lack of more lucrative alternatives? Indeed, in Thailand it has been stated that "the quality of by-catch and true trash fish is low and unsuitable for human consumption". (see Kungsuwan, 1995:88).

43. Recent information from the FAO (1997b:86) shows that in the Gulf of Thailand demersal fish stocks are now just one tenth of what they were 30 years ago, when trawling began in this area; nearly 70 per cent of the catch today is small, non-edible species of low commercial value and juveniles of species that would be of commercial importance if they were larger. The Gulf of Thailand has been called an "underwater desert" (Mathew, 1990:84), and the intense depletion of marine resources there has become a classic example of overexploitation (Pauly, 1998; 1995; Pauly and Chua, 1988). Hence, in the above case, apparent "economic efficiency" is nothing more than a manifestation of the serial depletion of fisheries resources.

44. Indeed, the concept of "trash fish" - a term incongruous with ecological processes - is evolving as fisheries resources become less available to burgeoning human populations: what was once discarded as worthless is now sought as a source of nutrients. Pauly (1995:287) discussed how this loaded term came about, and explained that it was a creation of the shrimp trawling industry.

45. As stated earlier, there is a long, and growing, list of publications on fisheries that have emphasized the pressing need to reduce bycatch destruction, and it is a widely accepted fact that shrimp trawling is by far one of the most destructive forms of fishing (e.g., Andrew and Pepperell, 1992; Alverson et. al., 1994; Teutscher, 1995a:3; 1995b; Clucas, 1997a; 1997b; Clucas and James, 1997; FAO, 1997a:11).

The Social Impacts of Shrimp Trawling:

46. Because shrimp trawling targets highly valued shrimp, there is high motivation to harvest as much and as fast as possible. This sort of competition for a common resource has led to "overcapitalization" of shrimp fleets globally (with the notable exception of Australia). The fact that there are more boats and gear than economically or ecologically warranted by the productive capacity of the fishery, is a further impulse for overfishing. Since shrimp are most abundant in coastal waters - especially in the tropics, fishing intensity for shrimp is greatest in inshore waters. As these same coastal waters are the traditional grounds of small-scale fishers, shrimp trawling logically leads to serious conflicts. The situation is further complicated as the trawlers fish ever-more intensely in response to declining shrimp stocks, resulting in an upward spiral of conflicts in coastal waters (e.g., Mathew, 1990; McGoodwin, 1990; Pauly, 1995).

47. Conflicts between small-scale fishers and modernized/industrialized/motorized fishers - notably shrimp trawls - are widely documented, and include many nations: e.g., Cameroon (Eyabi-Eyabi, 1995:20, 23); Gambia (Jallow, 1995:32); India (McGoodwin, 1990:130; Debnath, 1994); Indonesia (Mathew, 1990; McGoodwin, 1990); Malaysia (Mathew, 1990); Mexico (McGoodwin, 1990); North Yeman (McGoodwin, 1990:127); Suriname (Lieveld, 1995:80); Thailand (Mathew, 1990; Yamamoto, 1994); Venezuela (Guada, pers. com.); and Viet Nam (Tuoc, 1995:97). Pauly, one of the most respected fisheries biologists in Southeast Asia, has been discussing the problems of conflicts with trawlers in this region for years (Pauly, 1988; 1995; Pauly and Neal, 1985; Pauly and Chua, 1988), and as he has mentioned, there is a voluminous literature on the subject.

48. The pattern in India, for example, is typical of the development of shrimp fisheries in the Tropics. "The mainstay of the Indian fishing industry in economic terms is penaeid shrimp which also forms a major component of the marine products exports from India". (Pillai, 1995). Yet, there are numerous indicators that the main east coast trawler fleet in India is much larger than what the resource base can maintain, resulting in calamitous environmental as well as social and economic events: "In general, as prawn catches have declined as a result of uncontrolled (and often heavily and centrally subsidized) open access, the income derived from bycatch per se becomes proportionately more important to the small-scale operators commonly found around the coasts of India". "Considerable evidence exists that traditional fisheries are increasingly under threat from overfishing and that prawn trawling is much to blame". (Bostock and Ryder, 1995:41-42).

49. There is overwhelming evidence in Southeast Asia that shows that increased fishing effort - notably for shrimp - is to fuel "increasing needs for exports" (Tuoc, 1995). Elsewhere, the same pattern is repeated; in Gambia, where 87 per cent of the licensed industrial fleet in 1992 was foreign, shrimp, soles and cuttlefish were the main target species for export (Jallow, 1995:29-31). In Nigeria the shrimp fishery is also export oriented (Akande and Tobor, 1995:70-71), and in Suriname the fishery is not only for export, but mainly in foreign hands (Lieveld, 1995:77).

50. Not surprisingly, the lure of export earnings has resulted in overcapitalized shrimping fleets, which generally exert severe pressures on fisheries stocks, typically resulting in decreased harvests and rates of capture (presented as "Capture Per Unit Effort" or "CPUE" in studies of fisheries).

Information consistent with this scenario comes from many nations, including Cameroon (Eyabi-Eyabi, 1995: Tables 3 and 4), Nigeria (Akande and Tobor, 1995:70, Table 1) and Tanzania (Mgawe, 1995:82). Pauly (1988; 1995; Pauly and Neal, 1985; Pauly and Chua, 1988) has explained the same problem in Southeast Asia.

51. As described above, on a global level shrimp trawling produces at least 15 times as much discard as food product. Clearly, the relative benefits of shrimp fishing for human food, must be viewed in the context of the ecological costs from discards, bycatch and environmental destruction. Examined more carefully, within a social context, it must be appreciated that the vast majority of shrimp production in the tropics is destined for export to industrialized nations.

52. Hence, the production of shrimp not only entails a relatively high environmental cost, especially when compared to the direct nutritional benefits for humans, but these benefits are not destined for the people and ecosystems who pay the high costs. This is a classic case of one society bearing the costs of another society's benefits.

53. But the social implications are even more complex. What is generally hidden from view and rarely discussed, is the fact that while certain members of the exporting nation reap considerable financial benefit from these commercial activities, there are far more people in the exporting country who not only do not benefit, but whose resource base is depleted and whose already precarious way of life is further complicated and debilitated (Bailey, 1985:1986; 1988a; 1988b; 1988c; 1988d; 1989; Bailey and Zerner, 1988; Bailey and Jentoft, 1990; Bailey et al., 1986; Mathew, 1990).

Concern about Bottom Trawling, Particularly Shrimp Trawling:

54. Considering the above discussion, it is to be expected that there is tremendous concern about bottom trawling, particularly shrimp trawling. This concern has been expressed by specialists from different disciplines, for a variety of reasons.

55. Fisheries managers have pointed out the complexities of understanding and managing fisheries impacted by this type of activity. Bycatch from shrimp trawling yields mainly large numbers of small-sized fishes - individuals that have not yet reached maturity (see section above on Environmental Impacts of Bottom Trawling). However, fish harvesting is usually directed at individuals above a certain minimum size, to allow the animals to grow so that the yield from the fishery will be more productive. Concentrating exploitation on small, immature fish is known by fisheries biologists as "growth overfishing", and it is responsible for "considerable economic waste" (Murawski, 1995:7). However, the complications of managing fisheries impacted by bottom trawlers is even more complex because of the mixed species composition of the catch. "While trawling has increased the catch of shrimp and fish, increases of fishing effort has turned bycatch and discard issues into primarily a multi-species fishery exploitation problem. There may be a large number of species in the catch from these fisheries but the actual quantities of each species may be low making it necessary to understand more fully the nature and composition of the individual components and their interactions of a full assessment of the impact of the fishery is to be made. In essence the entirety of species, coastal and marine habitats appear to be under heavy exploitation but the impacts on sustainable use of resources are unknown". (FAO, 1997a:8). Given that there is a long litany of failed, single species fisheries, for which adequate information has been available to implement effective management (e.g., Ludwig et. al., 1993), the challenges of managing mixed species fisheries, concentrated on "undersized" individuals, are tremendous.

56. Fisheries managers, marine biologists and conservationists have also warned about the large scale environmental impacts from bycatch and alteration of the sea floor (see sections above on Environmental Impacts of Bottom Trawling and The Relevance of Shrimp Trawling to Bycatch

Problems). As Norse (1997b) described, "Bottom trawling is scouring continental shelf seabeds from the poles to the tropics". Again, the consequences of these impacts are poorly understood.

57. Conservationists, development specialists and social scientists have tried to alert decision makers in the fishing industry, commercial sector, government authorities, and multilateral agencies of the social risks and dangers of this form of exploitation (see section above on The Social Impacts of Shrimp Trawling). As ever, the difficulty is counterbalancing the head-long drive of profit-oriented activities which extract common resources with the long-term needs of society and the environment (Utting, 1995).

58. In summary, countless problems are attributed to bottom trawling - particularly shrimp trawling, starting with the fact that this is a highly unselective form of extracting renewable resources.

Calls to Ban Bottom Trawling:

59. As explained above (section on "Avoidance and Exclusion of Bycatch"), one of the greatest challenges before modern fisheries is to develop and implement selective fishing. The concern is global: for example, experts from the Marine Fishery Resources Development and Management Department, in Malaysia, have described the trawl as "a very destructive gear" and have explained that there is a great need to both reduce this destructiveness and to "strictly enforce the present legislation." (R. Bin Ali, 1995b). Similar sentiments have been expressed by officials from the Department of Fisheries in Thailand (Kungsuwan, 1996). Other enlightened fisheries administrators have warned that: "Unless species and size selectivity of fishing techniques are improved, tough new rules will place additional requirements on existing fisheries or fisheries may be closed all together" and "Once articulated, achieving our bycatch goals may indeed require that some fisheries as we know them will cease to exist." (Murawski, 1995:5 and 9; see also Clucas, 1997c:52).

60. Obviously, bottom trawling is the antithesis of selective fishing, and given the innumerable negative impacts of this form of resource extraction, it is to be expected that there have been many initiatives to prohibit trawling. For example, although infringements are common for lack of enforcement (Mathew, 1990; Pauly, 1995), trawling is legally banned in most of Indonesia (Mathew, 1990) along the Kerala coast of India during the monsoon season (SAMUDRA, 1994:316; Pillai in Prado and Rahman, 1995:10) and in several areas in Thailand (Kungsuwan, 1996). Not surprisingly, "in the trawl fisheries of the Gulf of Thailand there is now an outline proposal for a drastic reduction in capacity (FAO, 1996)". It has been estimated that a reduction of trawler effort by 30 to 40 per cent would result in a 132 per cent increase in trawler catch and a 147 per cent increase in value (Everett, 1997:47, 54-55).

61. Of those technologies introduced into the Third World in an effort to increase fisheries productivity, the bottom (or otter board) trawl is a prime example, and because of the extraordinarily high export value of shrimp and prawn products, shrimp trawling provides one of the clearest examples of unintended (and often unspoken) environmental and social consequences of development (as described in various sections above). Numerous writers have explained that fishing is a way of life and the resource base for millions of small scale fishers - people who have little if any political clout and few economic resources; thus, fisheries resources must be managed for the common good - not just for the elite and transnational export interests (SAMUDRA, 1994). Hence, people who have analysed the impacts of these activities have argued that "No effective fisheries management practices have been applied to trawl fisheries. Monitoring, surveillance and policing have consistently failed to protect resources and the marine environment, or the livelihoods of fishing communities. The battle for fish should be about securing and sustaining livelihoods for fishing communities around the world, and ensuring that important food supplies are maintained. In the countries of the South, more

than 100 million of the world's poorest people struggle to survive against an onslaught of Western technology, unleashed by commercial interests and consumer demand in the North". (O'Riordan, 1994).

62. In this light it is important to consider the results of the conference "The Struggles of Fishworkers: New Concerns for Support", which was attended by some 100 people representing 31 countries, including 7 Asian nations, among them India and Thailand. The attendees, including fishworkers, scientists, national and international policy makers, focused on the complex issues involving fisheries, as well as the many and diverse peoples who depend on them. In concluding the week-long meeting, they emitted a Declaration, in which they called for, inter alia, a ban on bottom trawling in tropical waters (SAMUDRA, 1994:321).

63. While banning bottom trawling will not be easy (e.g., R. Bin Ali, 1995b), nor will it occur quickly, there is an ever-growing appreciation of the environmental and social dangers of this form of fishing. Just as international pressure swelled, resulting in a ban on the use of cyanide and dynamite for fish extraction, as well as a UN moratorium on the use of high seas drift nets (Alverson and Hughes, 1995:14; Dilday, 1995:303), there is certain to be continued and greater calls to prohibit bottom trawling.

Alternate Methods for Harvesting Shrimp and Prawns:

64. Shrimp and prawns do not have to be caught in trawls. Certainly, Indonesian fishermen have been harvesting large numbers of shrimp for decades, without bottom trawls; pawn production from gill nets in 1986 was more than 900,000 tons (Mathew, 1990:26). The statistics presented by Kungsuwan (1996: Tables 3 and 4) clearly show that in Thailand, there are several ways to catch shrimp - other than trawling - that are productive and result in little or no bycatch. These include: acetes scoop nets, set bag nets, mullet gill nets, scoop nets, seines and stationary gear. It was reported that in the Andaman sea, set bag nets produced 33,946 tons of shrimp in 1993, out of a total of 55, 251 tons (61 per cent of the total): yet no bycatch at all was reported for this technique.

65. There is growing international recognition of the need to employ traditional fishing methods - and not just for shrimp (e.g., McGoodwin, 1990; FAO, 1995; Prado and Rahman, 1995:24-25). Indeed, using trawls to catch shrimp - in addition to causing countless environmental and social problems, as mentioned earlier - has definite drawbacks for the shrimp industry. It is noteworthy that the "highest quality [of shrimp] are normally caught from shrimp gill nets" - not in the industrialized trawls in Thailand (Kungsuwan, 1995:87).

Importance of Selective Fishing Gear and Bycatch Exclusion Devices:

66. Until bottom trawling is banned, practical means must be found to reduce the destructiveness of the gear. One of the first places to start is by making it more selective, so that non-target species are less severely impacted. Given the nature of bottom trawls, the simplest way to increase fishing selectivity is by incorporating Bycatch Excluder Devices (BEDs) in the nets (known also as "Bycatch Reduction Devices", or "BRDs").

67. As with other aspects of fisheries management and gear design, there are many questions that need to be worked out before excluder devices can be designed, tested, and finally offered to the industry. To stimulate more work and collaboration on this problem, the FAO has published a 150-page compilation of references on gear selectivity (Prado, 1992). One of the major questions that needs - urgently - to be answered and resolved is: "to what extent can the quantities of by-catch be reduced through activities such as the deployment of exclusion devices, the use of passive gear?" (Bostock and Ryder, 1995:41). Hence, fisheries experts have "...recognized a need for research into

the selectivity of fishing gear particularly of trawls used in tropical industrial fisheries". (FAO, 1997a:8, 14).

68. From research already carried out in some areas, it has been established that bycatch exclusion devices, in addition to reducing bycatch, wastage and environmental damage, can provide direct benefits to the fisherman by:

- reducing the time and effort needed to sort the catch (Clucas, 1997a:10; Prado, 1997:39);
- increasing the value of the catch, by reducing damage from bycatch, and increasing efficiency in handling and quality and value of the primary product (Clucas, 1997:10; Prado, 1997:39): for example, in Gambia, shrimp trawlers consider bycatch a problem for it may damage the shrimp, thus lowering the quality of the catch (Jallow, 1995:30);
- increasing the efficiency of fishing by reducing distortion to the gear from the bycatch (Clucas, 1997a:10; Prado, 1997:30).

These points, now being promoted by fisheries experts at the FAO, were described in 1982 when early models of TEDs were tested (Easeley, 1982).

Specialized BEDs - The TED:

69. It is widely recognized by fisheries specialists and conservationists that the capture of endangered species in fishing gear presents special problems for fisheries, and sea turtles are routinely discussed in this light (e.g., Easeley, 1982; National Research Council, 1990; Andrew and Pepperell, 1992; Alverson et al., 1994; FAO, 1994 Dilday, 1995; Everett, 1995; 1997; Hall 1995; Laist, 1995; Romine, 1995; FAO, 1997a; Prado 1997:25).

70. Turtles are caught and drown in different types of fishing gear, but it is often not easy to remove these risks, short of banning the fishery. High seas drift nets are a case in point. This gear was shown to be highly unselective, and a major source of mortality for diverse forms of marine life - including sea turtles and other endangered species; mounting international concern resulted in the United Nations General Assembly adopting, by consensus, a global moratorium on all large-scale pelagic driftnet fishing on the high seas (Alverson and Hughes, 1995:14; Dilday, 1995:302-303). Yet, turtles continue to drown in other fishing gear, such as gill nets, long lines and trawls. In the case of the first two, there is little that has been developed which can be done to abate mortality; reducing bycatch depends on fishers attending the gear at short intervals to remove captured turtles before they drown. However, in the case of trawls, considerable time, effort and resources have been invested over the past two decades in developing specialized BEDs - known variably as "trawl efficiency devices", "trawl excluder devices", "turtle excluder devices" or "TEDs". The TED is simply a BED adapted to exclude sea turtles from trawl nets.

71. Often fishers argue that turtle exclusion is not necessary because they see few turtles in their nets. However, fisheries biologists take a different perspective, for they must consider not only single boats, but also entire fleets operating in a country or region. Hence, at a FAO meeting on bycatch problems "…it was noted that examination of the magnitude of total discards can miss catches of special concern that are associated with particular fishing gears and locations. The occurrence of animals, such as reptiles [viz. marine turtles], mammals and birds is often incidental or rare but, over the entire fishery their numbers can be significant". (FAO, 1997a:6).

72. For example, only one turtle was caught in TED trials off the west coast of Peninsular Malaysia (Ali, 1997), and the data yield a CPUE estimate of 0.032258 (turtles caught per hour of trawling), which appears to be a low value. However, this value can be used to calculate the number

of turtles caught per boat per year (based on trawl effort data in R. Bin Ali, 1995b), and the estimate is 92 turtles per boat per year. Even if this yearly estimate were off by as much as factor of 10, and only 9 turtles were caught per boat per year, when a fleet of thousands of trawlers is taken into account, the yearly total could be several thousands of turtles caught in trawls per year.

73. TED designs which have been tested and certified by the NMFS have been shown - when properly installed and used - to exclude at least 97 per cent of the sea turtles that enter the net. The value of TEDs, however, goes beyond their function in saving marine turtles from drowning. Excluder devices are designed to exclude bycatch from trawls; not only do TEDs exclude sea turtles, but they are also effective at keeping other kinds of animals and debris out of trawl nets. Indeed, the "Georgia Jumper" - one of the more popular TEDs - was designed by shrimpers in the State of Georgia to exclude large jellyfish (known as "cannonballs") from their nets.

74. An analysis of TEDs done in 1982, using one of the first models, identified several benefits for shrimpers, including bycatch exclusion, reduced sorting and handling time of the catch, potential reduction in fuel usage, and improved dynamics of trawl operation (Easeley, 1982). Now that TEDs have been greatly refined, many former operational problems have been solved.

75. TEDs, depending on the model, can be very effective at excluding bycatch, thereby making shrimp trawls more selective and helping them to comply with one of the most pressing priorities in fisheries today. For example, studies on bycatch reduction have found that a decrease of more than 70 per cent of red snappers (Lutijanidae) in the 0 and 1 year age classes was achieved with certain TEDs (Graham, 1995; Harrington and Vendetti, 1995). These fish - if allowed to grow - would be of considerable commercial importance, but their removal as yearlings in the bycatch is not only unprofitable, but has resulted in the decimation of red snapper stocks in the Gulf of Mexico.

76. At the FAO-organized Expert Consultation on the Code of Conduct for Responsible Fishing, it was concluded that "in tropical shrimp fishing, the use of Turtle Excluder Devices has not only reduced the by-catch of turtles but further work in similar devices had increased the selectivity of the fishing gear and reduced the number of discards." (FAO, 1994:8). Prado, after reviewing gear modifications, stated that "the reduction of fish bycatch has, in many cases, to be combined with a turtle excluder". He concluded that "…results are, in many cases, excellent with up to 90 to 100 per cent escape of juveniles or 85 per cent escape of flatfish" (1997:29-31). Thus, at a FAO meeting on bycatch, turtle exclusion devices were included in the list of 12 "successful introductions of efficient selective fishing gear and harvesting practices" (FAO, 1997a:10).

77. Developed over the past two decades in the southeast shrimp fishery of the United States, TEDs have attracted interest elsewhere. Dr. E. G. Silas, former Director of the Central Marine Fisheries Research Institute, Cochin, India, recognized the value of TEDs for reducing mortality in sea turtles in Indian waters, and in 1983 he proposed testing and using TEDs in Indian trawlers (Silas et. al., 1983a; 1983b). Other fisheries specialists and conservationists in India have made similar recommendations (e.g., James et. al., 1989; Department of Fisheries et. al., 1996; Mohanty-Hejmadi, 1996; Sarkar et. al., 1996; Behera, 1997c; Pandav et. al., 1997). In 1995 it was reported that "Experiments are being undertaken by the Central Institute of Fisheries Technology in collaboration with the Marine Products Export Development Authority, Cochin, on the Turtle Excluder Device". (Pillai, 1995).

78. The Marine Fishery Resources Development and Management Department of Malaysia has carried out work, mostly on the east coast of Peninsular Malaysia, to increase selectivity of shrimp trawls. This included tests with bycatch excluder devices (BEDs), which were a "modified version of the US Turtle Excluder device (TED)". The work was conducted in 1986, so the BED would have been based on the early model of the NMFS TED, which was a rigid cage. On the basis of these tests,

done over 10 years ago, it was concluded that "BED is not suitable in Malaysian waters." (R. Bin Ali, 1995a; 1995b). However, there were operational problems with the early model of the TED, and during the intervening decade, the gear has been greatly modified and improved, making present-day TEDs much more efficient and easier to use.

79. Specialists from Malaysia have shown that there are clear needs for excluder devices. Studies carried out in Sabah found that "Research on shrimp trawler impacts on the mortality of adult sea turtles in the area has been identified as one of the most urgent aspects to be investigated." Hence, it was concluded that "similar device [TED] should be introduced in Malaysia" (Suliansa et. al., 1996). Furthermore, work done off the east coast of Peninsular Malaysia has emphasized the urgent need to reduce the destructiveness of trawling by using devices and techniques to improve selectivity: it is noteworthy that the possibility of banning trawls was even contemplated - although it was thought to be "almost impossible" (R. Bin Ali, 1995:13).

80. Recently, the Thai Turtle Free Device ("TTFD"), a modified "Super Shooter" (which in turn was developed from the "Georgia Jumper"), was tested off the western coast of Peninsular Malaysia, and it was "found to be suitable for the use by Malaysian fishermen" (Ali, 1997). Similar tests in Philippines (Dickson, 1997) and Thailand (Bundit et. al., 1997) also found that the TTFD TED performed adequately. Recent publications by the FAO have explained the value of trials being undertaken in Thai waters to test turtle excluder devices and bycatch reduction, as well as the need to expand this work to other countries (Everett (1997:55-56); and the Southeast Asian Fisheries Development Center in Bangkok has been promoting TED testing in the Southeast Asian region (SEAFDEC, 1996; 1997a; 1997b; 1997c).

81. Most of the work on TEDs in Southeast Asia has evaluated the rates of retention for shrimp and food fish, and there has been little attention paid to bycatch exclusion. Given the urgent need to reduce overfishing and to reverse the trend of intense, unselective fisheries in the region - especially from trawling, TEDs can serve an invaluable role in paving the way to more selective fisheries.

Mechanisms for Implementing Selective Fishing:

82. In general, there have been few incentives for "clean fishing" (i.e., using fishing gear and techniques which are least likely to result in bycatch and other environmental problems), but this is now changing (Murawski, 1995:6-7). According to the FAO: "In contrast to the modest successes recorded in developed countries with reducing discards, it was observed that in developing countries the problem of discards, notably from shrimp trawlers, was generally ignored." (FAO, 1997a:8). Although "the history of research regarding selectivity/bycatch reduction dates back almost a century…", "as far as developing countries are concerned, their participation in research has been mainly limited to the transfer of European or North American technology and testing it under conditions in tropical waters (often without enough consideration to local conditions)". "It should also be pointed out that, up to now, research and implementation of the results on selectivity and bycatch reduction in commercial fisheries has begun, in general, after the introduction of a new regulation. Recently a precautionary approach has been recommended with calls for changes in fishing practices to ensure better selectivity and a reduction of bycatch when a known risk of depleting stocks in any given fishery is thought to exist, even though it has not yet been scientifically proven". (Prado, 1997:26-27).

83. Unilateral decisions to reduce bycatch have been taken by several states. For example, it is illegal to discard at sea in Norway, and all fish caught must be landed. This has resulted in the use of separator grid technologies in the shrimp fishery, which are now compulsory. (Olsen, 1995; Clucas, 1997a:14; 1997c). Likewise, square mesh windows, designed to reduce capture of juvenile fishes,

are compulsory for certain finfish fisheries in European waters (Prado, 1997:28). Canada and Iceland have also instituted bans for discarding most fish species at sea. The logic behind banning discards is to force fishers to be more selective, so that they will fill their quotas with the most fish that are legal and lucrative (Clucas, 1997c:47-49)

84. Alverson and Hughes (1995:13-14) explained that although the need to solve bycatch problems has been known in fisheries biology for many years, the problem of bycatch has recently become a significant national policy issue in the United States, as in some other countries, due especially to public interest in endangered, charismatic animals - namely whales, dolphins, sea birds and sea turtles. Catalyzed by concerns over these "flagship species", most fisheries have today been scrutinized for their relationship with bycatch. In response to public demand, relayed by government representations, the United Nations General Assembly adopted, by consensus, a resolution on bycatch and discards in 1994, and this issue is now clearly on the international agenda (Dilday, 1995:304; Clucas, 1997a:1-3).

85. While acknowledging "that multilateral, negotiated approaches to fishery bycatch and discard issues are preferable to unilateral pronouncements" (Dilday, 1995:305), "US officials have supported restricting the imports of fishery products from sources which fail to incorporate bycatch reduction so as not to penalize fishers in the US who have modified their fishing" (Murawski, 1995:6-7). Dilday (1995:305) described US diplomatic involvement in fisheries bycatch issues, concluding that "because of the importance of fisheries to many nations, international bycatch policy should minimize social and ecological conflict, be independent of ideological differences, and be based on sound conservation principals".

86. As Everett, from the FAO Department of Fisheries summarized: "Stringent regulations and harsh penalties will not do the whole job of reducing [bycatch or] discards, especially when enforcement is underfunded and/or inept. However good research and statistics, along with a combination of a carrot, a stick, and education, could well be a productive approach" (Everett, 1997:56). Clearly, if answers to seemingly simple biological and fisheries questions are illusive, implementing selective fishing is a complex challenge for many sectors of different societies. What is very clear, however, is that there is great urgency in implementing effective mechanisms for assuring selective fishing, and reducing overfishing - on a global level.

International Accords Regarding Bycatch:

87. Over the last few years the issue of bycatch has become a major concern at both national and global proportions (e.g., Alverson and Hughes, 1995:13; Dilday, 1995; Olsen, 1995). Reviews of the international accords, treaties, resolutions and initiatives to reduce bycatch and wastage in fisheries are discussed in numerous publications, notably diverse reports of the Food and Agriculture Organization of the United Nations, such as Everett (1995; 1997), Clucas (1997a; 1997c), Prado (1997), and (FAO, 1997a:1). On the basis of these studies, a few of the more salient international accords are summarized below.

88. UN Resolution (AIC.2149.I.50.Rev 1), entitled "Fisheries by-catch and discards and their impact on the sustainable use of the world's living marine resources" emphasizes that the issue: "warrants serious attention by the international community and a continued and effective response is necessary to ensure the long-term and sustainable development of fisheries" (Earth Negotiations Bulletin, 1995).
Other international resolutions expressing concern for the same issue include:

- UN General Assembly Resolutions 49/116 and 49/118 of December 1994;
- Resolution 50/25 of 5 December 1995;

- Rome Consensus on World Fisheries, March 1995;
- United Nations Agreement for the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, August 1995;
- Kyoto Declaration and Plan of Action, from the International Conference on the Sustainable Contribution of Fisheries to Food Security, December 1995.

89. As explained by the FAO (1997a:2-4), it is important to appreciate that "the conservation and management provisions of the Agreement for the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks have been negotiated to implement the UN Convention on the Law of the Sea". As a result, there are "obligations, new to international fisheries law, regarding the conservation and management of straddling and highly migratory fish stock fisheries". States must:

- assess the impacts of fishing … on target stocks and species belonging to the same ecosystem or dependent upon or associated with the target stocks [5 (d)];
- protect biodiversity in the marine environment [5 (g)];
- minimize pollution, waste, discards, catch by lost or abandoned gear, catch of non-target species, both fish and non-fish species … and impacts on associated or dependent species, in particular endangered species [5 (f)];
- implement the development and use of selective fishing gear and techniques [5 (f)];
- develop data collection and research programmes to assess the impact of fishing on non-target and associated or dependent species and their environment, and adopt plans which are necessary to ensure the conservation of such species and to protect habitats of special concern [6.3 [d]);
- be more cautious when information is uncertain, unreliable or inadequate. The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures [6.2].

90. The Code of Conduct for Responsible Fisheries (FAO, 1995) - adopted unanimously by the 28th Session of the FAO Conference on 31 October 1995 (Everett, 1997:45), further supports these concepts:

- "… where proper selective and environmentally safe fishing gear and practices exist, they should be recognized and accorded a priority in establishing conservation and management measures for fisheries" [6.6];
- phasing out of fishing gears and practices inconsistent with responsible fishing [7.6.4];
- "States should take appropriate measures to minimise waste, discards, catch by lost or abandoned gear, catch of non-target species, both fish and non-fish species, and negative impacts on associated or dependent species, in particular endangered species" and "…should promote to the extent practicable, the development and use of selective and environmentally safe gear and techniques." [7.6.9];
- "… encourage the development and implementation of technologies and operational methods that reduce discards. The use of fishing gear and practices that lead to the discarding of catch should be discouraged and the use of fishing gear and practices that increase survival rates of escaping fish should be promoted" [8.4.5];
- "Research on the environmental and social impacts of fishing gear and, in particular, on the impact of such gear on biodiversity and coastal fishing communities should be promoted." [8.4.8]
- "... should require that fishing gear, methods and practices, to the extent practicable, are sufficiently selective so as to minimise waste, discards, catch of non-target species … impacts on associated or dependent species ..." [8.5.1];

- "… should carry out studies on selectivity of fishing gear, the environmental impact of fishing gear on target species and on the behaviour of target and non-target species in relation to such fishing gear as an aid for management decisions and with a view to minimising non-utilised catches as well as safeguarding the biodiversity of ecosystems and the aquatic habitat." [12.10];

91. The Kyoto Declaration and Plan of Action (1995) called, inter alia, to "Promote fisheries through research and development aiming at: … (iii) reduction of discard mortality; (iv) development and use of selective environmentally safe and cost effective fishing gear and techniques"; [Declaration 15]. The Plan of Action includes points such as: "… increase efforts to estimate the quantity of fish, marine mammals, sea birds, sea turtles and other sea life which are incidentally caught and discarded in fishing operations; assess the effect on the populations or species; take action to minimise waste and discards including, to the extent practicable, the development and use of selective, environmentally safe and cost effective fishing gear and techniques; and exchange information on methods and technologies to minimise waste and discards". [7].

92. The World Food Summit (1996) established accords related to this topic, including: "The resource base for food, agriculture, fisheries and forestry is under stress and is threatened by problems such as desertifiction, deforestation, overfishing, overcapacity and discards in fisheries, losses of biodiversity,…" [24]. Flowing from the United Nations Convention on the Law of the Sea of 10 December 1982, the UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks, the FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, the World Food Summit Plan of Action further develops these concepts:

> "Implement sustainable fisheries management and practices, in particular the Code of Conduct for Responsible Fisheries, to address a responsible and sustainable utilization and conservation of fisheries resources in order to optimize the long-term sustainable contribution of fisheries resources to food security … minimizing wastes in fisheries, reducing excess fishing capacity and applying the precautionary approach in accordance with the UN agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks and Code of Conduct for Responsible Fisheries…" [d];

In this light, Sr. Joel Prado, of the Fishery Industry Division of FAO, has explained: "In line with the United Nations Convention on the Law of the Sea (1982) and Chapter 17 of Agenda 21, the 1995 UN Agreement Relating to the Conservation and Management of Stocks and Highly Migratory Fish Stocks (U.N. 1995) specifically refers to the problems of insufficiently selective gear and lack of sufficient co-operation between States". (Prado, 1997:25).

International Concern Over the State of the Oceans, Including Bycatch and Sea Turtles:

93. This concern for the state of the world's oceans, and more particularly the issues of devastated marine resources, overfishing, bycatch, and the environmental and social consequences of these problems is not limited to the rhetoric of governments and multinational organizations. There is considerable anxiety and grave concern in non-governmental groups and civilian associations. Unshackled by the pressures of international diplomacy, the statements of these concerned citizen groups, and people who depend directly on the resources in question, are not only germane, clear and succinct, but also more direct. In 1992 a 25-point Declaration was endorsed by a consortium of 104 organizations, representing millions of people in two dozen countries - including development organizations, environmental organizations, fishing communities, fishing companies, and even a canning company. It was explained that "even the most comprehensive bycatch strategies will only

be partial solutions if broader overfishing and structural issues in fisheries are not addressed." "Overfishing, waste, and discards leading to ecosystem degradation and collapse are tied, in large part, to over-capacity, non-selective technologies and the lack of cooperative systems of management, control, and enforcement based on strong conservation principles and objectives. Driven often by short term economic objectives and trade, these conditions drive an extremely destructive cycle that if allowed to continue into the future, will result in more social dislocation and environmental destruction". (Romine, 1995).

94. The Declaration, which specifically mentions sea turtles, makes it perfectly clear that "[m]any countries have pursued policies designed to maximize export earnings and fisheries production, often under pressure to service foreign debt, and often to the detriment of fish stocks, marine biodiversity, and coastal communities." [4]; and "[r]ising demand in industrialized countries for high-value species of fish is driving destructive fisheries practices worldwide, including shrimp trawl and aquaculture, with negative impacts on coastal wetlands, mangroves, marine biodiversity, and coastal fishing communities." [22]. Focusing on the mild language of intergovernmental accords, this Declaration states "[t]hough all relevant mechanisms or instruments should be viewed as opportunities to advance these issues, we would like to emphasize that codes of conduct, resolutions, declarations, or other agreements that are voluntary in nature are unacceptable substitutes for legally binding agreements." [7], and "[a]t a minimum, international agreements .... must contain provisions that require, rather than merely promote or encourage, the use of selective gears and techniques." [11].

95. Between the 2 and 7 of June 1994, nearly 100 people, from 31 nations, gathered in Cebu, Philippines to celebrate the Tenth Anniversary of the International Conference of Fishworkers and their Supporters. The Cebu Conference "The Struggles of Fishworkers: New Concerns for Support" resulted in a published proceedings of 345 pages, including a fourteen-page Declaration. What makes this conference remarkable is the integration of social and environmental issues, and the clarity with which they perceived the way in which the health of a society depends on the health of the environment. Among the recommendations were:

- "promote and facilitate greater awareness on coastal environmental issues affecting fishworker communities as well as help to develop [and] nurture strategies for a sustainable future";
- "provide international advocacy for appropriate action against coastal degradation and ... document and publicize examples of successful coastal environment management";
- "monitor relevant developments concerning negotiations and treaties for the protection of the environment at the international level and inform fishworkers' organizations of these developments";
- "launch an international campaign to achieve a complete ban on bottom trawling in tropical waters...";
- "facilitate continued discussion amongst fishworkers' organizations and help draft and elaborate a general set of agreed criteria against which to measure the social and ecological impacts of fishing technology to determine the acceptability of various technologies";
- "monitor the evolving situation of the fishworkers with regard to the impacts of international trade, structural adjustments, and other aspects of international economic policies (especially as they affect food security in certain countries) and promote the exchange of information on these questions among the fishworkers' organizations of different countries".

96. Another, just publicized, global initiative is "Troubled Waters: A Call for Action"; this statement, organized by the Marine Conservation Biology Institute, has been endorsed by more than 1,600 scientists, from 65 nations. It expresses concern about the state of the oceans and calls for immediate action to reverse the trends in widespread destruction to marine species and ecosystems.

Among the threats of greatest importance which were pointed out were overfishing and bottom trawls. The plight of endangered sea turtles, drowning in shrimp trawls and the need for TEDs, was not mentioned in the one page statement, for it was assumed that this was general knowledge (Norse, 1997b).

97. Resolutions for the 17th Annual Symposium on Sea Turtle Biology and Conservation, attended by more than 700 people from more than 30 nations, have recently expressed concern about: implementation of the FAO Code of Conduct for Responsible Fisheries, the status of the Interamerican Convention for the Protection and Conservation of Sea Turtles, incidental mortality sea turtles in shrimping operations in the United States, and the conservation activities for sea turtles in India (Wyneken, 1997).

98. Several other recent non-governmental undertakings have focused specifically on the issue of endangered sea turtles, the use of TEDs and questions of the present dispute:

- A Statement of Scientists, to date signed by more than 260 people from 31 countries, has emphasized the endangered status of marine turtles and the need to use TEDs to reduce mortality in shrimp trawling (Sierra Club Legal Defense Fund, 1997);
- A "TEDs Today" campaign in India had accumulated 104 signatures as of 11 November 1997, endorsing the need to provide protection for sea turtles by using TEDs in shrimp trawlers (Helpin Herps, 1997);
- An Amicus Brief on the present dispute before the WTO, prepared by the Foundation for International Environmental Law and Development (FIELD, 1997), representing the World Wide Fund for Nature (WWF) International, presented a series of arguments, seeking to "demonstrate the utility of a formal right of intervention for non-governmental organizations in disputes before the WTO". After presenting conservation information, the Amicus presents a detailed analysis of "Law and Policy", and concluded that "the measures under dispute relate to conservation, are necessary, and are not arbitrary or unjustifiable";
- A second Amicus Brief was prepared by the Center for International Environmental Law (CIEL, 1997), in collaboration with the Center for Marine Conservation (Washington, D. C.), the Red Nacional de Acción Ecológica (Chile), The Environmental Foundation, Ltd. (Sri Lanka), and The Philippine Ecological Network. It is preceded by a "Motion to Submit Amicus Brief" which argues that "Acceptance of the amicus brief enhances public participation in the WTO and improves the WTO dispute settlement process". This Amicus provides a second analysis of biological and technical matters, followed by a detailed analysis of "Legal Arguments", similarly supporting the need and legal basis for protecting sea turtles by using TEDs.

99. While many of these initiatives have been undertaken in 1997, it is important to realize that the international concern for the status of sea turtles and the use of TEDs is not new. For example, a Resolution urging maximum size limits, protection of habitat and TED's was passed unanimously at General Assembly of the 17th Session of the IUCN, in San José, Costa Rica, 1-10 February 1988. The members of the General Assembly of the International Union for the Conservation of Nature (now World Conservation Union) urged the United States to implement "federal regulations requiring the use of TEDs needed to prevent the capture and drowning of the critically endangered Kemp's ridley sea turtle or any other species of sea turtle." They further urged "member governments to enact and enforce national legislation to increase the conservation of sea turtles", inter alia, "[w]here sea turtles are present, require use of TEDs by shrimp trawlers, and control all other fishing methods as needed to minimize incidental catch, particularly off the nesting beaches during the breeding season." (Canin, 1989).

100. It is important to emphasize that the widespread, international manifestation of concern about the state of the oceans, destructive fishing operations, bottom trawling, shrimp trawling, endangered sea turtles and the use of TEDs is not some isolated social phenomenon. It is part of a burgeoning civilian concern about the social and environmental damages caused by modern fisheries practices. A case in point is a global civilian movement in response to the world shrimp industry. The documentation of intense environmental and social problems caused by industrial shrimp farming is vast and growing, and includes the work of the United Nations Research Institute of Social Development (Barraclough and Finger-Stich, 1995), citizen action groups (e.g., Quarto, 1992; Ahmed, 1997) and environmental scientists (e.g., Goss 1997). It is noteworthy that although the industry has characterized these civil movements as "extremist", the leaders of diverse national organizations include national heroes and Gandhians who espouse non-violence - despite the way in which the industry has treated them (Ahmed, 1997).

The Need for International Collaboration:

101. The complexities of protecting and managing migratory animals are tremendous, and have been recognized and acknowledged in different fora. For example, the officer in charge of selective fishing issues in the FAO wrote: "Regarding the management of the exploitation of shared resources or migratory stocks, a difficulty may result from the migration of growing fish [and other animals] to foreign waters. Such a situation requires that the management measures are taken not only at a national level but also at a regional level. Very selective and efficient fishing methods at a given time could affect future fish populations in the long term". (Prado, 1997:42).

102. Dilday (1995:303), from the US Department of State summarized the conundrum, between the need for international collaboration on the one side, and the exigency to catalyze action promoting changes in fisheries on the other: "[a]s in the case of the tuna/dolphin situation, the threat and imposition of US embargoes have helped encourage some countries to devote greater attention to sea turtle protection in the wider Caribbean. However, the Department of State recognizes that this approach may not be viable over the long term. Therefore, we are currently engaged in discussions with other countries to establish a multilateral regional convention for the protection and conservation of sea turtles."

Conclusions and Implications of the Above Discussion:

103. The state of the world's oceans is of grave concern, at national, regional and international levels; most fisheries stocks have been depleted or are being harvested at maximum yield, and untold species - including many that are endangered - are confronted by unrelenting pressures. Yet, intensity of fishing effort only seems to increase, and modern fishing methods are notoriously unselective, impacting far more than the species that are being targeted for human use. One of the clearest manifestations of this dilemma is shown by the statistics on bycatch. The effects of intense, unselective fishing - producing millions of tons of bycatch every year - are multifarious and ponderous. These practices seriously afflict fisheries stocks, the marine environment and coastal societies, both at present and for the future.

104. One of the most destructive of modern fishing practices is bottom trawling, particularly shrimp trawling, for it produces vast amounts of bycatch - most of which is discarded - and alters the ocean floor, reducing the quality of habitats. In addition to direct impacts on fisheries of commercial importance, the bycatch of shrimp trawlers includes countless other species of ecological and conservation importance: endangered species of sea turtles are among these.

105. Marine turtles are internationally regarded as endangered because many populations are greatly depleted from former times, and environments critical to their survival have been destroyed and contaminated - routinely at the hand of Man. Because they have complex life cycles, are slow to mature, and live for decades, these animals present tremendous challenges in terms of conservation; there is no simple prescription for conserving turtles or their habitats, but what is clear is that an interdisciplinary, integrated approach is absolutely essential. This means providing protection at all stages of the complex life cycle, in different environments and over extended periods of time. This simple fact means that by providing adequate protection for marine turtles, a multitude of animals, plants and environments must be considered and protected: conserving marine turtles leads to protecting a tremendous area of marine ecosystems. Put another way, marine turtles cannot be conserved if the marine environments in which they live are in jeopardy.

106. An animal that is applied as a symbol with which to protect many other species and ecosystems, is known as a "flagship species". The relevance of marine turtles to global conservation transcends issues of protecting endangered species and biological diversity, for it also bears directly on global fisheries matters. Because the most critical life history stages of sea turtles are those animals that are reproducing, or close to reproducing, and because it is those animals that are most at risk in fishing operations conserving sea turtles means dealing adequately with the bycatch issue. However, it is not easy to bring about changes in methods and attitudes in the fisheries industry, to convince them to modify gear, making it more selective, and to employ responsible operating procedures. Gear that is widely acknowledged to be among the most destructive (shrimp trawls) can be simply adapted (using TEDs) in order to conserve sea turtles; at the same time this small modification will serve both practically and ideologically as an invaluable step in developing responsible fisheries.

107. In this context, sea turtles have the potential to function as flagship species for solving much larger bycatch problems. Accomplishing this would not only save sea turtles, but it would help preserve other diverse marine organisms and marine environments. The success of these feats will be measured by a growing number of coastal peoples around the world whose livelihoods and very culture depend intimately on the availability of inshore marine resources.

108. In many respects, this deed would be "coming full circle", with technology providing a simple means for the turtle - an ancient religious and mythological symbol - to serve as savior in facilitating the resolution of a global dilemma.

DOCUMENTS APPENDED TO THIS ANNEX:

Canin, J., (1989), Greenpeace guest editorial: IUCN Resolution, Marine Turtle Newsletter, 44:1-4.

CIEL (Center for International Environmental Law), (1997), Amicus Brief to the Panel on United States - Import Prohibition of Certain Shrimp and Shrimp Imports, Center for Marine Conservation, Red Nacional de Acción Ecológica, The Environmental Foundation Ltd., and The Philippine Ecological Network, (vi), iii + 39 p.

FIELD (Foundation for International Environmental Law and Development), (1997), WWF Amicus Brief to WTO Shrimp-Turtle Dispute, World Wide Fund for Nature; Gland, Switzerland, 31 p.

Helpin Herps, (1997), TEDs today: Kachab's story, Helpin Herps; Ahmedabad, 9 p.

Norse, E. A., (1997b), Troubled Waters: A Call for Action, Marine Conservation Biology Institute; Redmond, Washington, 11 p.

Romine, T., Perspectives on the global fisheries crisis, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tomorrow, University of Alaska Sea Grant College Program; Fairbanks, Alaska, pp. 61-69.

SAMUDRA, (1994), The Cebu Conference, Proceedings, International Collective in Support of Fishworkers; Madras, India, 346 p.

Sierra Club Legal Defense Fund, (1997), Statement of Scientists, 12 p.

Wyneken, J., (1997), Resolutions of the 17th Annual Symposium on Sea Turtles Biology and Conservation, 4-8 March 1997, Orlando, Florida, US, 9 p.

Appendix 2

TRANSFER OF TED TECHNOLOGY

By Dr. J. Frazier

109. It is with some distress that I have read repeated criticisms that there have been no, incompetent, or inadequate attempts to transfer technology on TEDs to fishermen, fisheries officers, other authorities, conservationists and other concerned people outside of the United States. Having interacted with the gear specialists of the National Marine Fisheries Service (NMFS) responsible for the development of TEDs, I can assert from both professional and personal experience that they have consistently made considerable efforts for close to two decades to share their information with people interested in sea turtle conservation and reducing incidental mortality of turtles and other bycatch. A public presentation on the first results of their early work was given in November 1979, at the World Conference on Sea Turtle Conservation, attended by more than 300 participants from 40 different nations (McVae and Seidel, 1982). Publications explaining their work, gear modifications used and other details, have appeared for close to 20 years in international journals, such as International Council for Exploration of the Sea (Watson and Seidel, 1980) and the Marine Turtle Newsletter (Mrosovsky, 1982; Oravetz, 1984; Mitchell, 1991), as well as in regional fishery journals, such as Australian Fisheries (Oravetz and Grant, 1986). These specialists have also been participating for years in international meetings, such as the Annual Symposium on Sea Turtle Biology and Conservation (which is attended by hundreds of people, from dozens of countries), where TED specialists make public presentations on their work and take part in formal and informal discussions with other sea turtle biologists and conservationists (e.g., Christian and Harrington, 1988; Oravetz, 1988; Kendall, 1989; Klima et. al., 1989; Mitchell et. al., 1989; Mitchell et. al., 1990; Klima et. al., 1991; Oravetz, 1991).

110. In 1985, while I was working in the People's Republic of China, I sent a request to Mr. Chuck Oravetz, Protected Species Management Branch, NMFS, asking for information on TEDs, so that I could give it to colleagues in China. On receiving a large package of manuals and other materials, these were distributed to various people involved in coastal fisheries in China. In more recent years, while working on TEDs with students in Mexico (Olguin, 1996; Olguin et. al., 1996), requests for technical advice, reports and manuals, videos and other materials relevant to the design, installation, use, and evaluation of TEDs have always been fulfilled: the response of the specialists in the Pascagoula Laboratory of NMFS has always been helpful and friendly. From repeated discussions about TEDs and problems of bycatch with other colleagues in Latin America (e.g., Brazil and Costa Rica), it is clear that this sharing of information and readiness to assist in matters related to TEDs and bycatch reduction has been a constant feature of the NMFS specialists.

111. Since none of the delegations involved in the present dispute seem to appreciate the amount of effort and dedication, or the long history, of this attempt to transfer TED technology as widely as possible, a selection of supporting documents is being annexed (with the time constraints involved in preparing this report, the materials that are included are what could be acquired at very short notice).

112. The appended documents clearly show that there have been countless efforts to make TED technology available to fishers, fisheries officers, NGO's, and other organizations in various nations (documentation from nearly two dozen countries is included herein). There has been correspondence between NMFS specialists and leading sea turtle biologists in Australia, Canada, France, India, Japan, Malaysia and Philippines, some of which dates back to the early 1980's. In addition, they have conducted more than 40 workshops held outside the United States, each of which has involved not

only expenses in travel, communications and materials, but time and effort in planning and execution.

113. Having worked with the NMFS specialists, I can testify to their high level of interest, competence and commitment in sharing information and technology, instrumental in the reduction of mortality of sea turtles in fishing activities. I find absolutely no justification for characterizing the TED technology transfer programme, or the specialists responsible for it, as unconcerned, incompetent, or having ulterior motives to protect the domestic fishery for shrimp in the United States: the transparency, frankness and dedication with which they have been disseminating information on TEDs and other gear modifications for nearly two decades belies any such claims.

114. Finally, it must be emphasized that this desire to reduce destruction of endangered species and other bycatch, by assisting in the transfer of technology, is shared by other specialists from other agencies, for this attitude is central to a professional ethic. For example Ms. Julie Robins of the Queensland Department of Primary Industries, Australia, has also consistently provided helpful advice and materials to us in Mexico, while we have been working to gather more information on the effects of TEDs and how best to use them in Campeche.

115. This point is further supported by a perusal of the voluminous literature on bycatch, generated by academics, fisheries officers and gear technicians, in which descriptions - often in considerable detail - of experiments, gear modification and other innovations are publicly presented and discussed. For example, an international workshop on bycatch problems held in September, 1995 in Seattle, Washington, resulted in a published proceedings of 322 pages and 50 chapters (Wray, 1995). The reports, circulars and other publications produced by the Food and Agriculture Organization on the problem of bycatch (e.g., Clucas, 1997c; Clucas and James, 1997; FAO, 1994; 1995; 1997a; Prado, 1992), as well as meetings such as the SEAFDEC Regional Workshop on Responsible Fishing (24-27 June 1997), are further evidence of the intent to share experiences and information that will facilitate the development of more selective fishing gear and techniques, and in this way provide better protection for the world's marine resources. This approach is the antithesis of a profit-oriented venture, for although the information presented in these workshops and publications derives from work made possible from considerable amounts of private and state funding, state-of-the-art descriptions on methods for reducing bycatch problems are available to anyone who reads the reports, despite their institutional affiliation.

116. In summary, there are a number of specialists who have dedicated their professional careers to finding ways to improve modern fishing activities, making them more selective (and thus, less destructive) and allowing fishers to be more responsible. Advances of this nature are regarded as assets to humanity, and for this reason, these specialists are eager to share their information and skills with as wide a public as possible.

FORMAL MATERIALS APPENDED:

Chronological listing of TED technology transfer workshops: 5 p.

Mitchell, J. F., J. W. Watson, D. G. Foster and R. E. Caylor, (1995), The Turtle Excluder Device (TED): A Guide to Better Performance, US Department of Commerce; National Oceanographic and Atmospheric Administration; National Marine Fisheries Service; Southeast Fisheries Science Center, Mississippi Laboratories, Pascagoula, Mississippi. NMFS-SEFSC-366, 35 p.

Mitchell, J. F., J. W. Watson, D. G. Foster and R. E. Caylor, (1995), El Excluidor de Tortugas (TED): Un Guía para Mejorar su Funcionamiento, U.S. Department of Commerce; National Oceanographic and Atmospheric Administration; National Marine Fisheries Service; Southeast Fisheries Science Center, Mississippi Laboratories, Pascagoula, Mississippi. NMFS-SEFSC-366, 34 p.

Mitchell, J. F., J. W. Watson, D. G. Foster and R. E. Caylor, (1995), Tái-liêu hu'ó'ng dàn cách xú'-dung bô phân loc rùa biê'n môt cách hu'u hiêu, U.S. Department of Commerce; National Oceanographic and Atmospheric Administration; National Marine Fisheries Service; Southeast Fisheries Science Center, Mississippi Laboratories, Pascagoula, Mississippi. NMFS-SEFSC-366, 35 p.

Pelatihan Petugas Perikanan Dalam Rangka Pembuatan Konstruksi Dan Penggunnan TED (Turtle Excluder Device) Tanggal 14 S/D 19 Oktober 1996 Di Tegal (Jawa Tengah), (1996), Direktorat Bina Produski, Direktorat Jenderal Perikanan, Indonesia, 8 p.

H.E. Montri Darnpaiboon, (1996), Opening Address, Workshop on the Use of Turtle Free Devices in Shrimp Trawlers, 2 p.

H.E. Deputy Minister, (1996), The Report Address, Workshop on the Use of Turtle Free Devices in Shrimp Trawl Net, 3 p.

Thai Turtle Free Device, 13 p.

TED Regulations Summary Card: Single Grid Hard TEDs n. d. U.S. Department of Commerce; National Oceanographic and Atmospheric Administration; National Marine Fisheries Service; Southeast Fisheries Science Center, Mississippi Laboratories, Pascagoula, Mississippi. 2 p.

Tarejeta Resumen de Reglamentos de Tortuga (TED): TED Parilla Sensilla Rigida. n. d. U.S. Department of Commerce; National Oceanographic and Atmospheric Administration; National Marine Fisheries Service; Southeast Fisheries Science Center, Mississippi Laboratories, Pascagoula, Mississippi. 2 p.

Báng Tóm-Lu'o'c Nhû'g DiêuLê, Áp Dung Cho Nhû'g Bô-Phân Loc Rùa (TED). LOAI VÎ SÃT CÚ'NG. n. d. U.S. Department of Commerce; National Oceanographic and Atmospheric Administration; National Marine Fisheries Service; Southeast Fisheries Science Center, Mississippi Laboratories, Pascagoula, Mississippi. 2 p.

Seidel, W. R., (1997), Foreign TED technology transfer to India and Bangladesh: Trip report, Wilber R. Seidel, David Bernhart and Jack Forrester, May 2-14, 1997, United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Pascagoula, 5 p.

CORRESPONDENCE APPENDED:

Australia:

February 1982. C. J. Limpus to J. W. Watson, 1 p.
1 August 1983. C. A. Oravetz to C. Limpus, 1 p.
29 August 1983. C. A. Oravetz to C. Limpus, 1 p.
28 June 1984. A. Mager to C. Limpus, 1 p.
27 November 1985. C. A. Oravetz to C. J. Grant, 1 + 10 p.
26 February 1986. C. A. Oravetz to C. J. Grant, 1 p.
9 April 1986. C. J. Grant to C. A. Oravetz, 1 p.
21 May 1986. C. A. Oravetz to C. J. Grant, 1 p.
24 August 1987. W. D. Mitchell to P. W. Raymond, 1 + 2 p.
15 September 1987. C. A. Oravetz to D. Mitchell, 1 p.
24 March 1988. C. A. Oravetz to G. Goeden, 1 + 1 + 6 p.
5 February 1992. T. Tucker to C. A. Oravetz, 2 p.
24 March 1992. C. A. Oravetz to T Tucker, 2 p.
28 June 1996. J. F. Mitchell to J. McGilvray, 1 p.

Bangladesh:

9 June 1997. Powel to SEC STATE, 6 p.

Canada:

21 May 1986. J. W. Watson to W. H. L. Allsopp, 2 p.
29 May 1986. C. A. Oravetz to W. H. L. Allsopp, 2 p.
16 July 1995. J. F. Mitchell to J. J. Ryan, 1 p.
6 December 1995. J. F. Mitchell to N. Mrosovsky, 1 p.

Colombia:

14 July 1995. J. F. Mitchell to G. Piacenza, 1 p.
2 October 1995. J. F. Mitchell to P. Thiriez, 1 p.

Costa Rica:

21 May 1997. W. R. Seidel to J. Campos M., 2 p.

France:

6 November 1984. C. A. Oravetz to J. Fretey, 1 p.

India:

23 November 1982. J. C. Sawhney to J. W. Watson, 1 p.
14 December 1982. C. S. Kar to J. W. Watson, 1 p.
2 August 1991. Lorton to AM EMBASSY New Delhi, 2 p.
2 August 1991. Lorton to AM EMBASSY New Delhi, 1 p.
27 February 1992. Clark to SEC. STATE, 1 p.
30 July 1992. R. Ganapathy to P. Williams, 1 p.
13 August 1992. R. Ganapathy to "J. Oravitz", 1 p.
26 August 1992. C. A. Oravetz to R. Ganapathy, 2 p.
28 August 1992. R. Ganapathy to C. A. Oravetz, 1 p.
14 November 1994. B. Patnaik to R. Schmitten, 2 p.
9 January 1995. R. A. Schmitten to B. Patnaik, 1 p.
24 January 1995. M. K. Ahmed to R. A. Schmitten, 1 p.
15 March 1995. R. A. Schmitten to M. K. Ahmed, 2 p.
26 December 1995. R. A. Schmitten to H. S. Sarkar, 1 p.
30 December 1995. H. S. Sarkar to R. A. Schmitten, 1 p.
5 January 1996. Daley to SEC. STATE, 1 p.
29 March 1996. Wisner to SEC STATE, 2 p.
4 April 1996. Christopher to AM EMBASSY New Delhi, 1 p.
23 April 1996. W. R. Seidel to D. Roychowdhury, 2 p.
5 September 1996. W. R. Seidel to H. S. Sarkar, 2 p.
5 September 1996. W. R. Seidel to D. Roychowdhury, 2 p.
5 September 1997. B. Pradeep Kumar to W. R. Seidel, 1 p.

Indonesia:

24 August 1982. G. S. Posner to file, 5 p.
24 August 1982. C. A. Oravetz to L. Ogren, 1 p.
9 September 1982. W. R. Seidel to G. S. Posner, 1 p.
26 November 1982. Telegram from AM EMBASSY Jakarta, 1 p.
28 April 1983. C. A. Oravetz to E. C. Bricklemeyer, Jr., 1 + 5 p.
17 June 1983. W. R. Seidel to G. S. Posner, 2 p.
21 March 1985. C. A. Oravetz to Gomal, 1 p.

Italy:

30 November 1995. J. F. Mitchell to G. Gerosa, 1 p.

Japan:

1982 ?. S. Fuwa to J. W. Watson, 1 p.
15 November 1982. H. Enomoto to J. Watson, 1 p.
22 January 1996. J. F. Mitchell to K. Horikoshi, 1 p.

Malaysia:

26 February 1982, E. O. Moll to W. Seidel, 1 p.
25 March 1984. Chan Eng Heng to C. A. Oravetz, 1 p.
2 April 1984. C. A. Oravetz to Chan Eng Heng, 1 p.
26 March 1984. C. Leh to C. A. Oravetz, 1 p.
10 April 1984. C. A. Oravetz to C. Leh, 1 p.
20 July 1984. C. Leh to C. A. Oravetz, 1 p.
22 February 1985. C. A. Oravetz to Chan Eng Heng, 1 p.
2 August 1985. Ch'ng Kim Looi to C. A. Oravetz, 1 p.
27 August 1985. C. A. Oravetz to Ch'Ng Kim Looi, 1 p.
4 June 1996. A. Ali to Director NMFS, 1 p.

Mexico:

5 May 1994. J. F. Mitchell to J. Flores O., 1 p.

Morocco:

23 June 1996. J. F. Mitchell to Ministere des Peches Maritimes, 1 p.

Netherlands:

15 November 1982. A. J. Zwinenberg to J. W. Watson, 1 p.
22 November 1982. J. H duPon to J. W. Watson, 1 p.

Philippines:

2 September 1986. D. F. Ladra to C. A. Oravetz, 1 p.
15 September 1986. C. A. Oravetz to D. F. Ladra, 1 p.

Saudi Arabia:

26 June 1996. J. F. Mitchell to M Al Faiz, 2 p.

South Africa:

11 November 1982. G. R. Hughes to J. W. Watson, 1 p.
1 August 1983. C. A. Oravetz to G. R. Hughes, 1 p.
9 September 1983. G. R. Hughes to C. A. Oravetz, 2 p.

Switzerland (IUCN):

29 July 1986 A. J. Calio to K. R. Miller, 1 p.

Taiwan:

8 February 1996. J. F. Mitchell to I-Juinn Cheng, 1 p.

Thailand:

24 April 1992. Danuch Boonyaprapatsorn to J. Mortimer, 1 p.
17 September 1992. J. A. Mortimer to C. Oravetz, 1 p.
14 January 1993. C. A. Oravetz to Danuch Boonyaprapatsorn, 1 p.
19 January 1993. C. A. Oravetz to Danuch Boonyaprapatsorn, 1 p.

Turkey:

1 April 1997. J. F. Mitchell to E. Tasavak, 1 p.

United Kingdom:

1 April 1997. J. F. Mitchell to B. J. Godley, 1 p.

Venezuela:

5 May 1993. J. F. Mitchell to L. Ravago C., 1 p.
9 April 1996. J. F. Mitchell to R. C. Ward, 1 p.

Yemen:
18 January 1996. J. F. Mitchell to S. Wilson, 1 p.

ANNEX III

LITERATURE AND OTHER SOURCES CITED BY THE EXPERTS

Cited by Dr. S. Eckert:

Aguilar, R., J. Mas, X. Pastor, (1992), Impact of Spanish Swordfish Longline Fisheries on the Loggerhead Sea Turtle Caretta Caretta Population in the Western Mediterranean, pp. 1-6, in Richardson, J.I. and T.H. Richardson (Compilers), 1995, Proceedings of the Twelfth Annual Workshop on Sea Turtle Biology and Conservation, NOAA Tech. Memo. NMFS-SEFSC-361, 274 pp.

Aguilar, R., J. Mas, X. Pastor, (1993), Sea Turtles and Surface Longline Fishery, Greenpeace International Mediterranean Sea Project.

Ali, A. Alwi, S.S.S., Ananpongsuk, S., (1997), Experiments on the Use of Turtle Excluder Devices (TEDs) in Malaysian Waters, presentation from The Regional Workshop on Responsible Fishing, 24-27 June 1997, Bangkok, Thailand, 11 pp.

Amelang, M.A., (1994), Battling Bycatch Saving Snapper, Texas Shores (winter):23-28.

Andrews, H., (1993), Olive Ridleys Threatened in India: Letters Needed, Marine Turtle Newsletter, 61:5-6.

Argano, R.A.B.F., (1983), Status of Western Mediterranean Sea Turtles, Rapp. Comm. int. Mer Medit. 28(5):233-235.

Balazs, G.H., (1976), Green Turtle Migrations in the Hawaiian Archipelago, Biol. Conserv. 9:125-140.

Balazs, G.H., (1994), Homeward Bound: Satellite Tracking of Hawaiian Green Turtles From Nesting Beaches to Foraging Pastures, Proceedings of the Thirteenth Annual Symposium on Sea Turtle Biology and Conservation, NOAA Tech. Memo. NMFS-SEFSC-341, 278 pp.

Balazs, G.H., P. Craig, B.R. Winton, R.K. Miya, (1994), Satellite Telemetry of Green Turtles Nesting at French Frigate Shoals, Hawaii, and Rose Atoll, American Samoa, Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation, NOAA Tech. Memo. NMFS-SEFSC-351, 306 pp.

Balazs, G.H. and Pooley, S.G., (1994), Research Plan to Assess Marine Turtle Hooking Mortality: Results of an Expert Workshop Held in Honolulu, Hawaii, November 16-18, 1993, NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-201, 166 pp.

Bell, R. and J. I. Richardson, (1978), An Analysis of Tag Recoveries From Loggerhead Sea Turtles (Caretta Caretta) Nesting on Little Cumberland Island, GA., in: Proc FL & Interregional Conf on S.Turtles, 1976, Jensen Beach FL (G.E. Henderson, ed.) Fla Mar Res Publ 33:20-24.

Bhaskar, S., (1985), Mass Nesting by Leatherbacks in Irian Jaya, WWF Monthly Report, January.

Bowen, B. W., F.A. Abreu-Grobois, G.H. Balzas, N. Kamezaki, C.J. Limpus and R.J. Ferl, (1995), Trans-Pacific Migrations of the Loggerhead Turtle (Caretta Caretta) Demonstrated With Mitochondrial DNA Markers, Proc. Natl. Acad. Sci. 92:3731-3734.

Bowen, B., J.C. Avise, J.I. Richardson, A.B. Meylan, D. Margaritoulis and S.R. Hopkins-Murphy, (1993), Population Structure of Loggerhead Turtles (Caretta Caretta) in the Northwestern Atlantic Ocean and Mediterranean Sea, Conservation Biology 7(4):834-844

Bustard, H.R., (1979), Population Dynamics of Sea Turtles, in: Turtles: Perspectives and Research. M. Harless and H. Morlock (eds.), New York: John Wiley and Sons, Inc.

Chaloupka, M.Y. and J.A. Musick, (1996), Age, Growth and Population Dynamics, pp. 233-276, in: Biology of Sea Turtles, P.L. Lutz and J.A. Musick (eds.), CRC Press Inc. New York.

Chan, E.H., (1991), Sea Turtles, pp. 120-134, in: The State of Nature Conservation in Malaysia, R. Kiew (ed.), Malaysian Nature Society, Kuala Lumpur, Malaysia, 238 p.

Chan, E.H. and H.C. Liew, (1996), Decline of the Leatherback Population in Terengganu, Malaysia, 1956-1995, Chelon. Cons. and Biol. 2(2):196-203.

Chan, E.H. and H.C. Liew, (1996), A Management Plan for the Green and Hawksbill Turtle Populations of the Sabah Turtle Islands, Rpt to Sabah Parks, 26 p.

Chan, E.H., H.C. Liew, and Mazlan, A.G., (1988), The Incidental Capture of Sea Turtles in Fishing Gear in Terengganu, Malaysia, Biological Conservation 43(1988):1-7.

Chantrapornsyl, S., (1997), Status of Marine Turtles in Thailand, Country Report for Thailand presented at the Northern Indian Ocean Sea Turtle Workshop and Strategic Planning Session on Jan. 13-18, 1997 in Bhubaneswar, Orissa, India.

Chua, T.H., (1988a), Nesting Population and Frequency of Visits in Dermochelys Coriacea in Malaysia, J. Herp, 22(2):192-207.

Chua, T.H., (1988b), On the Road to Local Extinction: the Leatherback Turtle (Dermochelys Coriacea) in Terengganu, Malaysia, Proc. 11th Annl Sem. Malaysian Soc. Mar. Sci. 1988:153-158.

Cliffton, K., D.O. Cornejo, and R.S. Felger, (1982), Sea Turtles of the Pacific Coast of Mexico, in: K.A. Bjorndal (ed.), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Wash, D.C., p. 199-209.

Crouse, D.T., L.B. Crowder, and H. Caswell, (1987), A Stage-Based Population Model for Loggerhead Sea Turtles and Implications for Conservation, Ecology 68:1412-1423.

Crouse, D.T., M. Donnelly, M.J. Bean, A. Clark, W.R. Irvin, C.E. Williams, (1992), The TED Experience: Claims and Reality, Center for Marine Conservation, Environmental Defense Fund, and National Wildlife Federation, 17 p.

Crowder, L.B., S.R. Hopkins-Murphy, J.A. Royle, (1995), Effects of Turtle Excluder Devices (TEDs) on Loggerhead Sea Turtle Strandings With Implications For Conservation, Copeia 1995(4):773-779.

Das, B.B., (1998), (in press), Present Status of Gahirmatha Beach in Bhitara Knika Sanctuary, Orissa, Marine Turtle Newsletter 79:1-2.

Dash, M.C. and C.S. Kar, (1990), The Turtle Paradise Gahirmata, Interprint, New Dehli, India, p. 295.

Dayton, P.K., S.F. Thrush, M.T. Agardy, R. J. Hofman, (1995), Environmental Effects of Marine Fishing, Aquatic Conservation: Marine and Freshwater Ecosystems 5:205-232.

de Silva, G.S., (1987), The Leatherback and the Olive Ridley in Sabah Waters, Sarawak Mus. J. 58:115-123.

de Silva, G.S., (1982), The Status of Sea Turtle Populations in East Malaysia and the South China Sea, pp. 327-337, in: Bjorndal, K.A. (ed.), Biology and Conservation of Sea Turtles, Smithsonian Inst. Press, Wash. D.C.

Dodd, C.K. Jr., (1988), Synopsis of the Biological Data on the Loggerhead Sea Turtle, Caretta Caretta (Linnaeus 1758), U.S Fish Wildl. Serv. Biol. Rep. pp. 110.

Dredge, M.C.L. and N. Trainor, (1994), The Potential for Interactions Between Trawling and Turtles in the Queensland East Coast Trawl Fishery, pp. 136-141, in: James (Compiler), Proc. Austral. Marine Turtle

Conservation Workshop, Gold Coast, 14-17. Nov. 1990. Qld Dept. Environ. Heritage and Austral. Nature Cons. Agency.

Easley, J.E., (1982), A Preliminary Estimation of the Pay-Off to Investing in a Turtle Excluder Device for Shrimp Trawls, Final Report prepared for MONITOR, Int'I and CEE in cooperation with NMFS, unpub.

Eckert, K.L., (1993), The Biology and Status of Marine Turtles in the North Pacific Ocean, NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-186, 156 pp.

Eckert, S.A., (1997) in press, Perspectives on the Use of Satellite Telemetry and Other Electronic Technologies for the Study of Marine Turtles, With Reference to the First Year Long Tracking of Leatherback Sea Turtles, Proceedings of the Eighteenth Symposium on Sea Turtle Biology and Conservation, NOAA Tech. Memo., NMFS-SEFSC-XXX.

Eckert, S.A., E.H. Chan, H.C. Liew, K. Eckert, (1996), Shallow Water Diving by Leatherback Turtles in the South China Sea, Chelon. Cons. and Biol. 2(2):237-243.

Eckert, S. and L. Sarti M., (1997), Distant Fisheries Implicated in the Loss of the World's Largest Leatherback Nesting Population, Marine Turtle Newsletter 78:2-7.

Frazer, N., (1983), Survivorship of Adult Female Loggerhead Sea Turtles, Caretta Caretta, Nesting on Little Cumberland Island, GA, USA, Herpetologica 39(4):436-447.

Frazer, N.B., (1992), Sea Turtle Conservation and Halfway Technology, Cons. Biol. 6(2):1-8.

Frazer, N.B. and J.I. Richardson, (1985a), Annual Variation in Clutch Size and Frequency For Loggerhead Turtles, Caretta Caretta, Nesting at Little Cumberland Island, Georgia, USA, Herpetologica, 41(3):246-251.

Frazer, N.B. and J.I. Richardson, (1985b), Seasonal Variation in Clutch Size For Loggerhead Sea Turtles, Caretta Caretta, Nesting on Little Cumberland Georgia, USA, Copeia, 1985(4):1083-1085.

Frazer, N.B. and J.I. Richardson, (1986), The Relationship of Clutch Size and Frequency to Body Size in Loggerhead Turtles, Caretta Caretta, J. Herp, 20(1):81-84.

Groombridge, B. and R. Luxmoore, (1989), The Green Turtle and Hawksbill (Reptilia: Cheloniidae) World Status, Exploitation and Trade, Secretariat of the Conv. on Int'l Trade in Endangered Species of Wild Fauna and Flora, pp 601.

Harris, A.N. and I.R. Poiner, (1990), By-catch of the Prawn Fishery of Torres Strait: Composition and Partioning of the Discards Into Components that Float or Sink, Aust. J. Mar. Freshwater Res. 41:37-52.

Henwood, T.A. and W.E. Stuntz, (1987), Analysis of Sea Turtle Captures and Mortalities During Commercial Shrimp Trawling, Fish. Bull. 85(4):813-817.

Henwood, T.A., W. Stunz. and N. Thompson, (1992), Evaluation of U.S. Turtle Protective Measures Under Existing TED Regulations, Including Estimates of Shrimp Trawler Related Mortality in the Wider Caribbean, NOAA, Tech. Memo., NMFS-SEFSC-303. 14 pp.

Hill, G., (1991), Villagers in Thailand Protect Turtle Eggs, Bring Conservation Home, Marine Turtle Newsletter, 53:8-9.

Hill, G., (1992), The Sustainable Sea Turtle, Marine Turtle Newsletter, 58:2-5.

Hillestad, H.O., J.I. Richardson, and G.K. Williamson, (1978), Incidental Capture of Sea Turtles by Shrimp Trawlermen in Georgia, Proc Ann Conf S E Assoc Fish and Wildl Agencies 32:167-178

Hillestad, H.O., J.I. Richardson, C. McVea Jr., J.M. Watson Jr., (1979), Worldwide Incidental Capture of Sea Turtles, pp. 489-495, in: K.A. Bjorndal (Editor), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington D.C.

Hoekert, W.I.J. and A.D. Schouten, (1996), Is the Suriname Olive Ridley on the Eve of Extinction? First Census Data for Olive Ridleys, Green Turtles and Leatherbacks Since 1989, Marine Turtle Newsletter 75:1-4.

Hughes, G.R., (1974), The Sea Turtles of South-East Africa I. Status, Morphology and Distributions, Oceanographic Research Institute Investig. report 35:130 p.

Johannes, R.E., (1986), A Review of Information on the Subsistence Use of Green and Hawksbill Sea Turtles on Islands Under U.S. Jurisdiction in the Western Pacific Ocean, National Marine Fisheries Service, SWR-86-2, Honolulu, 41 pp.

Keinath, J.A.a.J.A.M., (1990), Dermochelys Coriacea (Leatherback Sea Turtle) Migration, Herp Review 21(4):92.

Kolinski, S., (1991), Outer Islands Turtle Project: Stage I, Final Report on the Olimaro Atoll Fieldwork, 22 pp.

Kraemer, J.E. and J.I. Richardson, (1979), Volumetric Reduction in Nest Contents of Loggerhead Sea Turtles (Caretta Caretta) (Reptilia, Testudines, Cheloniidae) on the Georgia Coast, J. Herp, 13(3):255-260.

Liew, H.C., Chan, E.H., Luschi, P. and Papi, F., (1995), Satellite Tracking Data on Malaysian Green Turtle Migration, Rend. Fis. Acc. Lincei 6:239-246.

Limpus, C.J., (1995), Myths, Reality and Limitation of Green Turtle Census Data, pp. 170-173, in: Keinath, J.A., D.E. Barnard, J.A. Musick, B.A. Bell (eds.), Proceedings of the Fifteenth Annual Symposium on Sea Turtle Biology and Conservation, 355 pp.

Limpus, C.J., J. Miller, C.J. Parmenter, D. Reimer, N. McLachlan, R. Webb, (1992), Migration of Green (Chelonia Mydas) and Loggerhead (Caretta Caretta) Turtles To and From Eastern Australian Rookeries, Wildl. Res., 19:347 pp.

Limpus, C.J. and. N. Nicholls, (1988), The Southern Oscillation Regulates the Annual Numbers of Green Turtles (Chelonia Mydas) Breeding Around Northern Australia, Aust. Wildl. Res. 15:157-161.

Luschi, P., Papi, F., Liew, H.C., Chan, E.H. and Bonadonna, F., (1996), Long-Distance Migration and Homing After Displacement in the Green Turtle (Chelonia Mydas): a Satellite Tracking Study, J. Comp. Physiol. A 178:447-452.

Maley, C., M. Murphy, and S. Kent, (1994), Georgia Sea Turtle Stranding and Salvage Network: 1979-1993, pp. 249-254, in: Bjorndal, K.A., A.B. Bolten, D.A. Johnson, P.J. Eliazar, Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation, NOAA, Tech. Memo., NMFS-SEFSC-351, 306 pp.

Marquez, M.R., R.A. Byles, P. Burchfield, M. Sanchez, P.J. Diaz F., M.A. Carrasco A., A.S. Leo P., and C. Jimenez O., (1996), Good News! Rising Numbers of Kemp's Ridleys Nest at Rancho Nuevo, Tamaulipas, México, Marine Turtle Newsletter 73:2-5.

Marquez, M.R., C. Penaflores, and J. Vasconcelos, (1996), Olive Ridley Turtles (Lepidochelys Olivacea) Show Signs of Recovery at La Escobilla, Oaxaca, Marine Turtle Newsletter 73:2-5.

Meylan, A., et. al., (1997 draft), Biology and Status of the Hawkbill in the Caribbean, IUCN/SSC Marine Turtle Specialist Group, Washington, DC, USA.

Meylan, A.B., (1982), Sea Turtle Migration - Evidence from Tag Returns, in: Bjorndal K.A. (ed.), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Wash, D.C., p. 91-100.

Mitchell, J.F., J.W. Watson, D.G. Foster, R.E. Caylor, (1995), The Turtle Excluder Device (TED): a Guide to Better Performance, NOAA, Tech. Memo., NMFS-SEFSC-366.

Mohanty-Hejmadi, P., (1994), Latest Word on the Talachua Jetty, Orissa, India, Marine Turtle Newsletter 67:1

Morreale, S.J., E.A. Standora, (1990), Occurrence, Movement and Behaviour of the Kemp's Ridley and Other Sea Turtles in New York Waters, Okeanos Ocean Research Foundation Annual Report, April 1989-April 1990.

Mortimer, J.A.a.C.A., (1987), Reproduction and Migrations of the Ascension Island Green Turtle Chelonia Mydas, Copeia 1:103-113.

Mrosovsky, N., S.R. Hopkins-Murphy, J.I. Richardson, (1984), Sex Ratio of Sea Turtles: Seasonal Changes, Science 225:739-741.

Murphy, T.M. and S.R. Hopkins-Murphy, (1989), Sea Turtle and Shrimp Fishing Interactions: A Summary and Critique of Relevant Information, Center for Marine Conservation, 52 pp.

Murphy, T.M. and S.R. Hopkins-Murphy, (1984), Sea Turtle and Shrimp Fishing Interactions: A Summary and Critique of Relevant Information, Wash. D.C.: Center for Marine Conservation, 60 pp.

Musick, J.A. and C.J. Limpus, (1996), Habitat Utilization and Migration in Juvenile Sea Turtles, in: Biology of sea turtles, P.-L. Lutz and J.A. Musick (eds), CRC Press Inc., New York, p. 137-164.

National Marine Fisheries Service and U.S. Fish and Wildlife Service, (1996a draft), Recovery Plan for U.S. Pacific Populations of the Green Turtle (Chelonia Mydas), National Marine Fisheries Service, Silver Spring, MD., 73 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service, (1996b draft), Recovery Plan for U.S. Pacific Populations of the East Pacific Green Turtle (Chelonia Mydas), National Marine Fisheries Service, Silver Spring, MD., 51 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service, (1996c draft), Recovery Plan for U.S. Pacific Populations of the Olive Ridley Turtle (Lepidochelys Olivacea), National Marine Fisheries Service, Silver Spring, MD., 42 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service, (1996d draft), Recovery Plan for U.S. Pacific Populations of the Loggerhead Turtle (Caretta Caretta), National Marine Fisheries Service, Silver Spring, MD., 49 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service, (1996e draft), Recovery Plan for U.S. Pacific Populations of the Hawksbill Turtle (Eretmochelys Imbricata), National Marine Fisheries Service, Silver Spring, MD., 72 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service, (1996f draft), Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle (Dermochelys Coriacea), National Marine Fisheries Service, Silver Spring, MD., 51 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service, (1993), Recovery Plan for Hawksbill Turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico, National Marine Fisheries Service, St. Petersburg, Florida, 47 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service, (1992), Recovery Plans for Leatherback Turtles in the U.S. Caribbean, Atlantic and Gulf of Mexico, National Marine Fisheries Service, Washington D.C., 52 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service, (1991a), Recovery Plan for U.S. Population of Loggerhead Turtle, National Marine Fisheries Service, Washington, D.C., 56 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service, (1991b), Recovery Plan for U.S. Population of Atlantic Green Turtle, National Marine Fisheries Service, Washington, D.C., 52 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service, (1992), Recovery Plan for the Kemp's Ridley Sea Turtle (Lepidochelys Olivacea), National Marine Fisheries Service, St. Petersburg, Florida, 40 pp.

National Research Council, (1990), Decline of the Sea Turtles: Causes and Prevention, National Academy Press, Washington D.C., 259 pp.

Ogren, L.H., Watson, J.W. and Wickham, D.A. (1977), Loggerhead Sea Turtles, Caretta Caretta, Encountering Shrimp Trawls, Mar. Fish. Rev. 39(11):15-17.

Pandav, B. and B.C. Choudhury, (1995), A note on the Occurance of Sub-Adult Olive Ridley Turtles Along the Gahirmatha Coast, Marine Turtle Newsletter, 71:15-17.

Poiner, I.R., R.C. Buckworth, and A.N.M Harris, (1990), Incidental Capture and Mortality of Sea Turtles in Australia's Northern Prawn Fishery, Aust. J. Mar. Freshwater Res., 41:97-110.

Pritchard, P.C.H., (1973), International Migrations of South American Sea Turtles (Cheloniidae and Dermochelyidae), Anim Behav 21:18-27.

Pritchard, P.C.H., (1981a), Marine Turtles of the South Pacific, p. 253, in: Bjorndal, K.A. (ed.), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Wash. D.C., 583 pp.

Pritchard, P.C.H., (1981b), Marine Turtles of Micronesia, p. 263, in: Bjorndal, K.A. (ed.), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Wash. D.C., 583 pp.

Pritchard, P.C.H., (1982), Nesting of the Leatherback Turtle, Dermochelys Coriacea in Pacific Mexico, with a New Estimate of the World Population Status, Copeia 4:741-747.

Renaud, M., G. Gitschlag, E. Klima, A. Shah, D. Koi, and J. Nance, (1991), Evaluation of the Impacts of Turtle Excluder Devices (TED's) on Shrimp Catch Rates in Coastal Waters of the United States Along the Gulf of Mexico and Atlantic, September 1989 through August 1990, NOAA, Tech. Memo., NMFS-SEFC-288.

Renaud, M., G. Gitschlag, E. Klima, A. Shah, J. Nance, C. Caillouet, A. Zein-Eldin, D. Koi and F. Patella, (1990), Evaluation of the Impacts of Turtle Excluder Devices (TED's) on Shrimp Catch Rates in Coastal Waters of the United States Along the Gulf of Mexico and South Atlantic, March 1988 through July 1989, NOAA, Tech. Memo., NMFS-SEFC-254.

Richardson, J.I., (1978), Results of a Hatchery for Incubating Loggerhead Sea Turtle (Caretta Caretta) Eggs on Little Cumberland Island, Georgia, Florida Marine Research Publ. 33:15.

Richardson, J.I., (1982), A Population Model for Adult Female Loggerhead Sea Turtles (Caretta Caretta) Nesting in Georgia, Ph.D. Dissertation, Univ. Georgia, Athens, Georgia, 233 p.

Richardson, J.I., (1992), An Investigation of Survivorship, Mortality, and Recruitment of Adult Female Loggerhead Sea Turtles Nesting at Cumberland Island National Seashore, Georgia (1987-1991), Final Report, Georgia Sea Turtle Cooperative, University of Georgia, Athens, 35 p.

Richardson, J.I., T.H. Richardson and M.W. Dix, (1976), Population Estimates for Nesting-Female Loggerhead Sea Turtles (Caretta Caretta) in the St. Andrews Sound Area of Southeastern Georgia, USA, Florida Marine Research Pub No. 33:34-38.

Richardson, T.H., J.I. Richardson, C. Ruckdeschel and M.W. Dix, (1976), Remigration Patterns of Loggerhead Sea Turtles (Caretta Caretta) Nesting on Little Cumberland and Cumberland Islands, Georgia, Florida Marine Research Pub. No. 33:39-44.

Ross, J.P., (1996), Caution Urged in the Interpretation of Trends at Nesting Beaches, Marine Turtle Newsletter 74:9-10.

Sarti, L.M., S.A. Eckert, N. Garcia T. and A.R. Barragin, (1996), Decline of the World's Largest Nesting Assemblage of Leatherback Turtles, Marine Turtles Newsletter 74:2-4.

Senalak, S. and Sujittosakul, T., (1997), Post-Evaluation of Thai Turtle Free Devices (TTFDs) Use With Shrimp Trawlers in East Coast of the Gulf of Thailand, Tech. Paper No. 4, Dept. of Fisheries, Kasetglang, Chatuchak, Phaholyothin Road, Bangkok 10900, Thailand, 16 pp.

Shaver, D., (1996), Head-started Kemp's ridley Turtles Nest in Texas, Marine Turtle Newsletter, 74:5-7

Shoop, C.R., Kenney, R.D., (1992), Seasonal Distribution and Abundances of Loggerhead and Leatherback Sea Turtles in Waters of the Northeastern United States, Herpetological Monographs 1991(6): 67 p.

Spotila, J.R., A.E. Dunham, A.J. Leslie, A.C. Steyermark, P.T. Plotkin, and F.V. Paladino, (1996), Worldwide Population Decline of Dermochelys coriacea: Are Leatherback Turtles Going Extinct?, Chel. Cons. Biol. 2(2):209-222.

Stabenau, E.K., T.A. Heming, J.F. Mitchell, (1991), Respiratory, Acid-Base and Ionic Status of Kemp's Ridley Sea Turtles (Lepidochelys Kempi) Subjected to Trawling, Comp. Biochem. Physiol. 99A(1/2):107-111.

Stark, M., (1993), Field Survey of Leatherback Nesting Beaches in the Bird's Head Region, Irian Jaya, Is Renewed, Marine Turtle Newsletter, 60:1-4.

Stinson, M.L., (1984), Biology of Sea Turtles in San Diego Bay, California and in the Northeastern Pacific Ocean, MS Thesis, San Diego State University.

Stoneburner, D.L., J.I. Richardson and G.K. Williamson, (1982), Observations on the Movement of Hatchling Sea Turtles Caretta-Caretta, Copeia 1982(4):963-965.

Stoneburner, D.L. and J.I. Richardson, (1981), Observations on the Role of Temperature in Loggerhead Turtle Nest Site Selection, Copeia 1:238-241.

Taylor, B.L., (1993), Population Viability Analysis for the Little Cumberland Island Loggerhead Turtle Population, Unpub Draft Report.

Van Buskirk, J.a.C., L.B., (1994), Life-History Variation in Marine Turtles, Copeia 1994(1):66-81.

Wetherall, J.A., G.H. Balazs, R.A. Tokunaga and Marian Y.Y. Yong, (1993), Bycatch of Marine Turtles in North Pacific High-Seas Driftnet Fisheries and Impacts on the Stocks, Bull. of the N. Pacific Commission, 53(III):519-538 .

Witzell, W.N., (1983), Synopsis of Biological Data on the Hawksbill Turtle, Eretmochelys Imbricata (Linnaeus, 1766), FAO Fisheries Synopsis No. 137.

Cited by Dr. J. Frazier:

Ackerman, R.A., (1997), The nest environment and the embrionic development of sea turtles, in: P.L. Lutz and J. A. Musick (eds.), The Biology of Sea Turtles, CRC Press, New York, pp. 83-106.

Ahmed, F., (1997), In defense of land and livelihood: Coastal communities and the shrimp industry in Asia, in: Consumers' Association of Penang, CUSO, Inter pares, Sierra Club of Canada, Quebec, Canada, 34 pp.

Akande, G. and J. Tobor, (1995), Utilization of by-catch of shrimp in Nigeria, in: F. Teutscher (technical secretary), Report and Proceedings, TCDC Workshop, Utilization of By-Catch from Shrimp Trawlers, Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, pp. 70-76.

Ali, A., S.S.S. Alwi and Suppachai A., (1997), Experiments on the use of turtle excluder devices (TEDs) in Malaysian waters, in: Regional Workshop on Responsible Fishing, Bangkok, Thailand, 24-27 June 1997, SEAFDEC/RESF/97/WP.7, 11 pp.

Ali, R.B., (1995a), The progress of selectivity studies in Malaysia, in: J. Prado and F. A. Rahman (eds.), FAO/INFOFISH/SEAFDEC, Workshop on Research in the Selectivity of Fishing Gear and Methods in South East Asia and Selective Shrimp Fishing, Chendering, Malaysia, 28-30 May 1995, FAO Fisheries Circular No. 902, Food and Agriculture Organization of the United Nations, Rome, p. 5.

Ali, R.B., (1995b), Shrimp trawl fishing methods in Malaysia, in: J. Prado and F.A. Rahman (eds.), FAO/INFOFISH/SEAFDEC, Workshop on Research in the Selectivity of Fishing Gear and Methods in South East Asia and Selective Shrimp Fishing, Chendering, Malaysia, 28-30 May 1995, FAO Fisheries Circular No. 902, Food and Agriculture Organization of the United Nations, Rome, pp. 11-13.

Alverson, D.L., M.H. Freeberg, S.A. Murawski and J.G. Pope, (1994), A global assessment of fisheries bycatch and discards, in: FAO Fisheries Technical Paper 339, Food and Agriculture Organization of the United Nations, Rome, xxi + 236 pp.

Alverson, D.L. and S.E. Hughes, (1995), Bycatch: From emotion to effective natural resource management, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, pp. 13-28.

Alverson, R., (1995), Introduction, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, p. 3.

Andrew, N.L. and J.G. Pepperell, (1992), The by-catch of shrimp trawl fisheries, in: A.D. Ansell and R.N. Gibson (eds.), Oceanography and Marine Biology, Annual Review, 30:527-565.

Anon, (1982), Migratory turtle threatened, Statesman, 7 December 1982.

Anon, (1985), Saving the ridley turtles, Statesman, 20 April 1985.

Anon, (1986), Rockets or ridleys? Oryx, 20(4).

Anon, (1992), Orissa jetty poses threat to sanctuary, The Telegraph, 29 December 1992.

Anon, (1996), Endangered turtles struggle to survive, Statesman, 9 January 1996.

Anon, (1997a), A breeding ground which has turned turtle, Pioneer, 7 February 1997.

Anon, (1997b), Over 5,000 olive ridleys, 10 dolphins die in 3 months, Sun Times, 23 March 1997.

Anon, (1997c), Mass killing of turtles in Orissa, Asian Age, 24 March 1997.

Anon, (1997d), Dead turtles found in Gahirmatha, Telegraph, 24 March 1997.

Anon, (1997e), High mortality of young turtles worries experts, Indian Express, 4 April 1997.

Anon, (1997f), Govt curbs to help Ridley turtle, Pioneer, 10 June 1997.

Anon, (1997g), Orissa plan to save sea turtles, Indian Express, 10 November 1997.

Anon, (1997h), Scientists, greens call for protection of olive ridley turtles, Sun Times, 10 November 1997.

Anon, (1997i), Shrinking rookery of turtles causes concern, Times of India, 10 November 1997.

Anon, (1997j), Gahirmatha, Indian Express, 12 November 1997.

Arauz, R., (1990), The importance of testing TED efficiency in Costa Rica, in: T. H. Richardson, J. I. Richardson and M. Donnelly (compilers), Proceedings of the Tenth Annual Symposium on Sea Turtle Biology and Conservation, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NMFS-SEFSC-278, pp. 51-53.

Arauz, R., (1996a), A description of the Central American shrimp fisheries with estimates of incidental capture and mortality of sea turtles, in: J.A. Keinath, D.E. Barnard, J.A. Musick and B.A. Bell (compilers), Proceedings of the Fifteenth Annual Symposium on Sea Turtle Biology and Conservation, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida, NMFS-SEFSC-387, pp. 5-9.

Arauz, R., (1996b), Size of turtles captured along the western coast of Costa Rica during commercial shrimp operations, Sea Turtle Restoration Project, Tibás, Costa Rica, 3 pp.

Arauz, R., (1997), Letter to J. Frazier, 17 December 1997, 1 p.

Arauz, R., R. Vargas, I. Naranjo and C. Gamboa, (1997a), Analysis of the incidental capture and mortality of sea turtles in the shrimp fleet of Pacific Coasta Rica, Sea Turtle Restoration Project, Tibás, Costa Rica, 5 pp.

Arauz, R., I. Naranjo, R. Rojas and R. Vargas, (1997b), Evaluation of the Supper Shooter and Seymour turtle excluder devices with different deflector bar spacing in the shrimp fishery of Pacific Costa Rica, Sea Turtle Restoration Project, Tibás, Costa Rica, 13 pp.

Asrar [ne Firdous], F.F., (1995?), Marine turtles of Pakistan, Sind Wildlife Management Department, Karachi, 5 pp.

Auster, P.J., R.J. Malatesta, R.W. Langton, L. Watling, P.C. Valentine, C.L.S. Donaldson, E.W. Langton, A.N. Shepard and I.G. Babb, (1996), The impacts of mobile fishing gear on seafloor habitats in the Gulf of Maine (Northwest Atlantic): Implications for conservation of fish populations, Reviews in Fisheries Science, 4(2):185-202.

Bailey, C., (1985), The blue revolution: the impact of technological innovation on Third-World fisheries, The Rural Sociologist, 5(4): 259-266.

Bailey, C., (1986), Government protection of traditional resource use rights - the case of Indonesian fisheries, in: D.C. Korten (ed.), Community Management: Asian Experience and Perspectives, Kumarin Press, West Hartford, Conn, pp. 292-308.

Bailey, C., (1988a), The social consequences of tropical shrimp mariculture development, Ocean & Shoreline Management, 11:31-44.

Bailey, C., (1988b), Optimal development of Third World Fisheries, in: M.A. Morris (ed.), North-South Perspectives on Marine Policy, Westview Press, Boulder, Colorado, pp.105-128.

Bailey, C., (1988c), The political economy of fisheries development in the Third World, Agricultural and Human Values, 5(1&2):35-48.

Bailey, C., (1988d), The political economy of marine fisheries development in Indonesia, Indonesia, 46:25-38.

Bailey, C., (1989), Social issues in Third World fisheries development, in: J.S. Thomas, L. Maril and E.P. Durrenberger (eds.), Marine Resource Utilization: A Conference on Social Science Issues, University of South Alabama Publication Services, Mobile, Alabama, pp. 137-143.

Bailey, C., D. Cycon and M. Morris, (1986), Fisheries development in the Third World: The role of International agencies, World Development, 14(10/11):1269-1275.

Bailey, C. and C. Zerner, (1988), Community-based fisheries management institutions in Indonesia, Marine Anthropological Studies, 5(1):1-17.

Bailey, C. and S. Jentoft, (1990), Hard choices in fisheries development, Marine Policy, 14(4):333-344.

Bailley, J. and B. Groombridge, (1996), IUCN Red List of Threatened Animals, IUCN, Gland, Switzerland.

Balazs, G.H., (1980), Synopsis of biological data on the green turtle in the Hawaiian Islands, U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA Technical Memorandum NMFS-SWFSC-7, 141 pp. (cited by K.L. Eckert, (1993), The biology and population status of marine turtles in the north Pacific Ocean, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA Technical Memorandum NMFS-SWFSC-186, viii + 156.).

Balazs, G.H., (1982), Driftnets catch leatherback turtles, Oryx, 16(5):428-430.

Balazs, G.H., (1985), Impact of ocean debris on marine turtles: entanglement and ingestion, in: R.S. Shomura and H.O. Yoshida (eds.), Proceedings of the Workshop on the Fate and Impact of Marine Debris, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA Technical Memorandum NMFS-SWFSC-54, pp. 387-429.

Balazs, G.H., (1994), Homeward bound: Satellite tracking of Hawaiian green turtles from nesting beaches to foraging pastures, in: B.A. Schroeder and B.E. Witherington (compilers), Proceedings of the Thirteenth Annual Symposium on Sea Turtle Biology and Conservation, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NMFS-SEFSC-341 pp.

Balazs, G.H. and J.A. Wetherall, (1991), Assessing impacts of North Pacific high-seas driftnet fisheries on marine turtles: Progress and problems, presented at: North Pacific Driftnet Scientific Review Meeting; Sidney, British Columbia, Canada, 11-14 June 1991, 15 pp.

Balazs, G.H., P. Craig, B.R. Winßton and R.K. Miya, (1994), Satellite telemetry of green turtles nesting at French Frigate shoals, Hawaii, and Rose Atoll, American Samoa, in: K.A. Bjorndal, A.B. Bolten, D.A. Johnson and P.J. Eliazar (compilers), (1994), Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NMFS-SEFSC-351, pp. 184-187.

Balzas, G.H., D.M. Ellis, W.G. Gilmartin and L.K. Katahira, (1997), Use of satellite telemetry to determine the migratory routes and resident foraging habitats of nesting hawksbill turtles: A case study in the Hawaiian Islands, in: The International Workshop on the Management of Marine urtles, 3-4 February 1997, Kuta, Bali, Indonesia, 10 p.

Balzas, G.H. and D.M. Ellis, in press, Satellite telemetry of migrant male and female green turtles breeding in the Hawaiian Islands, In: Proceedings of the Sixteenth Annual Symposium on Sea Turtle Biology and Conservation, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NMFS-SEFSC.

Balzas, G.H, L.K. Katahira and D.M. Ellis, in press, Satellite tracking of hawksbill turtles nesting in the Hawaiian Islands, in: Proceedings of the Sixteenth Annual Symposium on Sea Turtle Biology and Conservation,

U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NMFS-SEFSC.

Barraclough, S. and A. Finger-Stich, (1995), Some ecological and social implications of commercial shrimp farming in Asia, United Nations Research Institute for Social Development, Draft report, 55 pp.

Behera, C., (1997a), Ref. No. TED/PS-97, date 20.3.97, Survey & video recording of mass killing of olive ridley sea turtles in the Gahirmatha coast by Project Swarajya on 18th & 19th of March '97 (The survey and video recording of mass killing of olive ridley sea turtles in the Gahirmatha beach under the Bhitarkanika Wildlife Sanctuary on 18th & 19th of March '97 by Project Swarajya, Cuttack: A Brief Report, Project Swarajya, Cuttack, Orissa, India.), 5 pp.

Behera, C., (1997b), Letter to J. Frazier, 7.4.1997, 1 p.

Behera, C., (1997c), Letter to Earth Island Institute, 8.4.97, 2 pp.

Bjorndal, K.A., (1997), Foraging ecology and nutrition of sea turtles, in: P.L. Lutz and J.A. Musick (eds.), The Biology of Sea Turtles, CRC Press, New York, pp. 199-231.

Bjorndal, K.A. and Zug G.R., (1995), Growth and age of sea turtles, in: K.A. Bjorndal (ed.), Biology and Conservation of Sea Turtles, (revised edition), Smithsonian Institution Press, Washington, D.C., pp. 599-600.

Bolten, A.B. and G.H. Balazs, (1995), Biology of the early pelagic stage - the "lost year", in: K.A. Bjorndal (ed.), Biology and Conservation of Sea Turtles (revised edition), Smithsonian Institution Press, Washington, D.C. pp. 579-581.

Bostock, T. and J. Ryder, (1995), By-catch usage in India: An NRI/ODA BOBP project experience, in: F. Teutscher (technical secretary), Report and Proceedings, TCDC Workshop, Utilization of By-Catch from Shrimp Trawlers, Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, pp. 40-50.

Bowen, B.W., (1995), Molecular genetic studies of marine turtles, in: K.A. Bjorndal (ed.), Biology and Conservation of Sea Turtles (revised edition), Smithsonian Institution Press, Washington, D.C. pp. 585-587.

Bowen, B.W. and S.A. Karl, (1997), Population genetics, phyogeography, and molecular evolution, in: P.L. Lutz and J.A. Musick (eds.), The Biology of Sea Turtles. CRC Press, New York, pp. 29-50.

Brongersma, L., (1972), European Atlantic turtles, Zool, Verhand, Leiden, 121:1-318.

Bundit, C., Yuttana, T., Supachai, A., Somboon, S., Lertchai, P., Peera Aosomboon and A. Ali, (1996), The experiments on turtle excluder devices (TEDs) for shrimp trawl nets in Thailand, Regional Workshop on Responsible Fishing, Bangkok, Thailand, 24-27 June 1997, SEAFDEC/RESF/97/WP.6. 43 pp.

Canin, J., (1989), Greenpeace guest editorial: IUCN Resolution, Marine Turtle Newsletter, 44:1-4.

Carr, A., M.H. Carr and A.B. Meylan, (1978), The ecology and migrations of sea turtles, 7, The West Caribbean green turtle colony, Bulletin American Museum Natural History, 162(1):1-46.

Chaloupka, M.Y. and J.A. Musick, (1997), Age, growth, and population dynamics, in: P.L. Lutz and J.A. Musick (eds.), The Biology of Sea Turtles, CRC Press, New York, pp. 233-276.

Chan, E.H., (1991), Sea turtles, in: R. Kiew (ed.), The State of Nature Conservation in Malaysia, Malayan Nature Society, Kuala Lumpur, pp. 120-134.

Chan, E.-H. and H.-C. Liew, (1986), Characteristics of an exploited tropical shallow-water demersal fish community in Malaysia, in: J.L. Maclean, L.B. Dizon and L.V. Hosillos (eds.), Proceedings of the First Asian Fisheries Forum, 26-31 May 1986, Manila, Asian Fisheries Society, pp. 349-352.

Chan, E.H. and H.C. Liew, (1996a), Decline of the leatherback population in Terengganu, Malaysia, 1956-1995, Chelonian Conservation and Biology, 2(2):196-203.

Chan, E.H. and H.C. Liew, (1996b), A management plan for the green and hawksbill turtle populations of the Sabah turtle islands, A Report to Sabah Parks.

Chan, E H., H.C. Liew and A.G. Mazlan, (1988), The incidental capture of sea turtles in fishing gear in Terengganu, Malaysia, Biological Conservation 43:1-7.

Chee, P.-E., (1997), A review of the bycatch and discards in the fisheries of Southeast Asia, in: I.J. Clucas and D.G. James (eds.), (19979, Papers presented at the technical consultation on Reduction of Wastage in Fisheries, Tokyo, Japan, 28 October - 1 November 1996, FAO Fisheries Report, No. 547, Supplement, Rome, FAO, pp. 257-270.

Choudhury, B.C., in press, Country Report: India, Proceedings of the Northern Indian Ocean Sea Turtle Workshop and Strategic Planning Session, Bhubaneshwar, Orissa, India, 13-18 January 1997.

Christian, P.A. and D.L. Harrington, (1988), Soft turtle excluder device (TED) testing at Cape Canaveral, Florida, in: B.A. Schroeder (compiler), Proceedings of the Eighth Annual Workshop on Sea Turtle Biology and Conservation, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NOAA Tec. Mem. NMFS-SEFC-214, pp.7-10.

CIEL (Center for International Environmental Law), (1997), Amicus Brief to the Panel on United States - Import Prohibition of Certain Shrimp and Shrimp Imports, Center for Marine Conservation, Red Nacional de Acción Ecológica, The Environmental Foundation Ltd., and The Philippine Ecological Network, (vi), iii + 39 pp.

Clifton, K., D.O. Cornejo and R.S. Felger, (1982), Sea turtles of the Pacific coast of Mexico, in: K.A. Bjorndal (ed.), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C. pp. 199-209.

Clucas, I.J., (1997a), Reduction of fish wastage - an introduction, in: I.J. Clucas and D.G. James (eds.), (1997), Papers presented at the technical consultation on Reduction of Wastage in Fisheries, Tokyo, Japan, 28 October-1 November 1996, FAO Fisheries Report, No. 547, Supplement, Rome, FAO, pp. 1-14.

Clucas, I.J., (1997b), The utilisation of bycatch/discards, in: I.J. Clucas and D.G. James (eds.), 1997, Papers presented at the technical consultation on Reduction of Wastage in Fisheries, Tokyo, Japan, 28 October-1 November 1996, FAO Fisheries Report, No. 547, Supplement, Rome, FAO, pp. 59-67.

Clucas, I., (1997c), A study of the options for utilization of bycatch and discards for marine capture fisheries, FAO Fisheries Circular, No. 928, Rome, FAO, 59 pp.

Clucas, I.J. and D.G. James (eds.), (1997), Papers presented at the technical consultation on Reduction of Wastage in Fisheries, Tokyo, Japan, 28 October-1 November 1996, FAO Fisheries Report, No. 547, Supplement, Rome, FAO, 338 pp.

Cornelius, S.E., (1982), Status of sea turtles along the Pacific coast of middle America, in: K.A. Bjorndal (ed.), Biology and Conservation of Sea Turtles (revised edition), Smithsonian Institution Press, Washington, D.C. pp. 211-219.

Crowder, L.B., D.T. Crouse, S.S. Heppell and T.H. Martin, (1994), Predicting the impact of turtle excluder devices on loggerhead sea turtle populations, Ecological Applications 4(3):437-445.

Crowder, L.B., S.R. Hopkins-Murphy and J.A. Royle, (1995), Effects of turtle excluder devices (TEDs) on loggerhead sea turtle strandings with implications for conservation, Copeia, 1995(4):773-779.

Crouse, D., (1996), Message sent to "readers of CTURTLE, subject: Malaysian headstarting announcement, 4 November 1996, Center for Marine Conservation, Washington, D.C. 3 pp.

Crouse, D.T., L.B. Crowder and H. Caswell, (1987), A stage-based population model for loggerhead sea turtles and implications for conservation, Ecology, 63(5): 1412-1423.

Crouse, D.T. and N.B. Frazer, (1995), Population models and structure, in: K.A. Bjorndal (ed.), Biology and Conservation of Sea Turtles (revised edition), Smithsonian Institution Press, Washington, D.C. pp. 601-603.

Dash, M.C. and C.S. Kar, The Turtle Paradice: Gahirmatha, Interprint, New Delhi, 295 pp.

Debnath, H., (1994), Country Report - India. In: SAMUDRA. The Cebu Conference, Proceedings. International Collective in Suport of Fishworkers; Madras, India. pp. 232-241.

DENR (Department of Environment and Natural Resources, The Philippines) and WRI (World Resources Institute, United States), (1997), Conservation and Sustainable use of coastal and marine biological diversity - The way forward, A view from Southeast Asia, Recommendions from the southease Asia Regional Workshop on Marine Biodiversity and the Convention on Biolgocial Diversity, October 24-25, 1996, Subic Bay, the Phillippines, To the Thrid Meeting of the Subsidiary Body on scientific, Technical, and Technological Adivce (SBSTTA), September 1-5, 1997, Montreal, Canada, 10 pp.

Department of Fisheries, Government of Orissa and Project Swarajya, (1997), Workshop on Turtle Excluder Device, 11-14 November 1996, Paradip, A report, pag. var.

Dickson, J.O., (1997), Study on turtle excluder and by-catch reduction devices in the Philippines, Regional Workshop on Responsible Fishing, Bangkok, Thailand, 24-27 June 1997, SEAFDEC/RESF/97/WP.6, 22 pp.

Dilday, W.E., (1995), U.S. diplomatic involvement in fisheries bycatch issues, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, pp. 301-305.

di Silva, G.S., (1982), The status of sea turtle population in East Malaysia and the South China Sea, in: K.A. Bjorndal (ed.), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C., pp. 327-337.

Dodd, C.K., (1988), Synopsis of the biological data on the loggerhead sea turtle, Caretta caretta (Linnaeus, 1758), U.S. Fish and Wildlife Service, Biological Report 88(14), 110 pp.

Donnelly, M., (1994), Sea turtle mariculture: A review of relevant information for conservation and commerce, Center for Marine Conservation, Washington, D.C., 113 pp.

Dutton, P.H., G.H. Balazs and A.E. Dizon, in press, Genetic stock identification of sea turtles caught in the Hawaii-based pelatic longline fishery, in: Proceedings of the 17th Annual Sea Turtle Symposium.

Earth Negotiations Bulletin, (1995), Resolution (AIC.2149.I.50.Rev 1) of the UN General Assembly Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks: entitled Fisheries by-catch and discards and their impact on the sustainable use of the world's living marine resources (cited by Bostock, T. and J. Ryder (1995), By-catch usage in India: An NRI/ODA BOBP project experience, in: F. Teutscher (technical secretary), Report and Proceedings, TCDC Workshop, Utilization of By-Catch from Shrimp Trawlers; Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, p. 40).

Easeley, J.E., (1982), A preliminary estimate of the payoff to investing in a turtle excluder device for shrimp trawls, Final report prepared for Monitor International and The Center for Environmental Education, 16 pp.

Eckert, K.L., (1993), The biology and population status of marine turtles in the north Pacific Ocean, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA Technical Memorandum NMFS-SWFSC-186, viii + 156.

Eckert, K.L., (1995), Anthropogenic threats to sea turtles, in: K.A. Bjorndal (ed.) (1995), Biology and Conservation of Sea Turtles (revised edition), Smithsonian Institution Press, Washington, D. C., pp. 611-612.

Eckert, S.A. and L. Sarti M., (1997), Distant fisheries implicate in the loss of the world's largest leatherback nesting population, Marine Turtle Newsletter 78:2-7.

Emerson, D.K., (1980), Rethinking artisanal fisheries development: Western concepts, Asian experiences, Staff working paper No. 423, The World Bank, Washington, D.C., (cited in: C. Bailey, (1985), The blue revolution: the impact of technological innovation on Third-World fisheries, The Rural Sociologist, 5(4):259-266.)

Europa, (1997), The Europa World Year Book, (1997), Volume II Kazakstan - Zimbabwe, Europa Publications, London.

Everett, G.V., (1995), Fisheries bycatch and discards: A report from FAO, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, pp. 279-283.

Everett, G.V., (1997), Actions to reduce wastage through fisheries management, in: I.J. Clucas and D.G. James (eds.), Papers presented at the technical consultation on Reduction of Wastage in Fisheries, Tokyo, Japan, 28 October - 1 November 1996, FAO Fisheries Report No. 547, Supplement, Rome, FAO, pp. 45-58.

Eyabi-Eyabi, G., (1995), Utilization of by-catch from shrimp trawlers in Cameroon, in: F. Teutscher (technical secretary), Report and Proceedings, TCDC Workshop, Utilization of By-Catch from Shrimp Trawlers, Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, pp. 19-24.

Fairley, S. (ed.), (1995), Overfishing: Causes and consequences, The Ecologist 25(2/3): 41-128.

FAO, (1994), Report of the Expert Consultation on the Code of Conduct for Responsible Fishing - Fishing Operations, Sidney, British Colombia, Canada, 6-11 June 1994, FAO Fisheries Report No. 506, Food and Agriculture Organization of the United Nations, Rome, 16 pp.

FAO, (1995), Code of Conduct for Responsible Fisheries, Food and Agriculture Organization of the United Nations, Rome, 41 pp.

FAO, (1997a), Report of the Technical Consultation on Reduction of Wastage in Fisheries, Tokyo, Japan, 28 October - 1 November 1996, FAO Fisheries Report No. 547, Food and Agriculture Organization of the United Nations, Rome, 27 pp.

FAO, (1997b), Review of the state of world fisheries and aquaculture, Food and Agriculture Organization of the United Nations, Rome.

FIELD (Foundation for International Environmental Law and Development), (1997), WWF Amicus Brief to WTO Shrimp-Turtle Dispute, World Wide Fund for Nature, Gland, Switzerland, 31 pp.

Firdous, F., (1989), Dead turtles on Karachi coast, typescript, Sind Wildlife Management Board, Karachi, Pakistan.

Firdous, F., (1991), A turtle's journey from Pakistan (Karachi) to India (Gujarat), Marine Turtle Newsletter 53:18-19.

Firdous, F., in press. Marine turtle conservation in Pakistan, Proceedings of the Northern Indian Ocean Sea Turtle Workshop and Strategic Planning Session Bhubaneshwar, Orissa, India, 13-18 January 1997.

Folke, C. and N. Kautsky, (1989), The role of ecosystems for a sustainable development of aquaculture, Ambio, 18(4):234-243.

Fraser, T.M., Jr., (1960), Rusembilan: A Malay Fishing Village in Southern Thailand, Cornell University Press, Ithaca, New York.

Frazier, J., (1980), Exploitation of marine turtles in the Indian Ocean, Human Ecology, 8(4):329-370.

Frazier, J., (1982), Status of sea turtles in the central western Indian Ocean, in: K.A. Bjorndal (ed.) (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C., pp. 385-398.

Frazier, J., (1997a), Guest Editorial: Inter-American Convention for the Protection and Conservation of Sea Turtles, Marine Turtle Newsletter, 78:7-13.

Frazier, J., (1997b), Sustainable development: modern elixir or sack dress?, Environmental Conservation, 24(2):182-193.

Frith, R., (1946), Malay Fishermen: Their Pesant Economy, Kegan Paul, Trench, Trubner & Co., Ltd., London.

García-Rodríguez, E., Utilization of shrimp by-catch in Cuba, in: F. Teutscher (technical secretary), Report and Proceedings, TCDC Workshop, Utilization of By-Catch from Shrimp Trawlers, Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, pp. 25-28.

Gates, C.E., R.A. Valverde, C.L. Mo, A.C. Cháves, J. Ballesteros and J. Peskin, (1996), Estimating arribada size using a modified instantaneous count procedure, Journal of Agricultural, Biological, and Environmental Statistics, 1(3):275-287.

George, R.H., (1997), Health problems and diseases of sea turtles, in: P.L. Lutz and J.A. Musick (eds.), The Biology of Sea Turtles, CRC Press, New York, pp. 363-385.

Gibbons, D., (1976), Public policy towards fisheries development in Peninsular Malaysia: A critical review emphasizing Penang and Kedah, in: L.J. Fredericks (ed.), Proceedings of the Seminar on the Development of Fisheries Sector in Malaysia, Kuala Lumpur (cited by Mathew, S., (1990), Fishing Legislation and Gear Conflicts in Asian Countries, SAMUDRA, International Collective in Support of Fishworkers, Madras, India, No. 1, 124 pp.)

Ginsberg, J., (1981), The status of sea turtles in Tarutao National Park, Satun, Thailand, Tigerpaper (FAO), 8(2):27-29.

Gordon, A., (1990), By-catch from Indian Shrimp Trawlers in the Bay of Bengal, The Potential for Improved Utilization, Report on work undertaken in India between September 1988 and October 1989, (cited by T. Bostock and J. Ryder (1995), By-catch usage in India: An NRI/ODA BOBP project experience, in: F. Teutscher (technical secretary), Report and Proceedings, TCDC Workshop, Utilization of By-Catch from Shrimp Trawlers, Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, p. 42).

Goss, J., (1997), Conflict and resistance in Indian shrimp aquaculture, Third World Resurgence, No. 84:2-3.

Graham, G.L., (1995), Finfish bycatch from the southeastern shrimp fishery, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, pp. 115-119.

Groombridge, B., (1989), Aerial survey of the Baluchistan coast (Pakistan), Marine Turtle Newsletter, 46:6-9.

Groombridge, B., A.M. Kabraji and A.L. Rao, (1988), Marine turtles in Baluchistan (Pakistan), Marine Turtle Newsletter, 42:1-2.

Guinea, M.L. and S. Whiting, (1997), Sea turtle deaths coincide with trawling activities in Northern Australia, Marine Turtle Newsletter, 77:11-14.

Hall, M.A., (1995), Strategic issues in managing fishery bycatches, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, pp. 29-32.

Harrington, D.L. and R.A. Vendetti, Jr., (1995), Shrimp trawl bycatch reduction in the southestern United States, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, pp. 12-135.

Harris, A.N. and I.R. Poiner, (1990), By-catch of the prawn fishery of Torrews Strait; Composition and partitioning of discards into components that float or sink, Aust. J. Mar. Freshwater Res, 41:37-52.

Helpin Herps, (1997), TEDs today: Kachab's story, Helpin Herps, Ahmedabad, 9 pp.

Henwood, T.A. and W.E. Stuntz, (1987), Analysis of sea turtle captures and mortalities during commercial shrimp trawling, Fisheries Bulletin 85(4):813-817.

Heppell, S.S., L.B. Crowder and D.T. Crouse, (1996a), Models to evaluate headstarting as a management tool for long-lived turtles, Ecological Applications, 6(2):556-565.

Heppell, S.S., C.J. Limpus, D.T. Crouse, N.B. Frazer and L.B. Crowder, (1996b), Population model analysis for the loggerhead sea turtle, Caretta caretta, in Queensland, Wildlife Research, 23:143-159.

Hill, G., (1992), The sustainable sea turtle, Marine Turtle Newsletter, 58:2-5.

Hillestad, H.O., J.I. Richardson, C. McVae, Jr. and J.M. Watson, Jr., (1982), Worldwide incidental capture of sea turtles, in: K.A. Bjorndal (ed.), (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C., pp. 489-495.

Hillman, J.C. and T. Gebremariam, (1996), The status of sea turtle conservation in Eritrea, in: S.L. Humphrey and R.V. Salm (eds.), Status of sea turtle conservation in the western Indian Ocean, Regional Seas Reports and Studies, UNEP, Nairobi, Kenya, No. 165, pp. 41-56.

Hilmi, A.H., (1997), Shrimp trawl net (modified) in Malaysia, Southeast Asian Fisheries Development Center and Marine Fishery Resources, Kuala Terengganu, Malaysia, 13 pp.

Hirth, H.F., (1997), Synopsis of the biological data on the green turtle Chelonia mydas (Linnaeus 1758), U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Biological Report 97 (1), v + 120 pp.

Howell, K.M. and C. Mbindo, (1996), The status of sea turtle conservation in Tanzania, in: S.L. Humphrey and R.V. Salm (eds.), Status of sea turtle conservation in the western Indian Ocean, Regional Seas Reports and Studies, UNEP, Nairobi, Kenya, No. 165, pp. 73-80.

IDRC (International Development Research Centre), (1982), Fish By-Catch...Bonus from the Sea, International Development Research Centre, Ottawa, Canada, 163 pp.

IUCN (World Conservation Union), (1995), A Global Strategy for the Conservation of Marine Turtles, IUCN/Species Survival Commission, Cambridge, UK, 26 pp.

IUCN (World Conservation Union), (1996), A Marine Turtle Conservation Strategy and Action Plan for the Western Indian Ocean, IUCN/Species Survival Commission, Cambridge, UK, 24 pp.

IUCN (World Conservation Union), in press, A Marine Turtle Conservation Strategy and Action Plan for the Northern Indian Ocean, IUCN/Species Survival Commission, Cambridge, UK.

Jackson, J.B.C., (1997), Reefs since Columbus, Coral Reefs, 16.

Jallow, A.M., (1995), Recent positive and negative experiences on the utilization of shrimp by-catch in the Gambia, in: F. Teutscher (technical secretary), Report and Proceedings, TCDC Workshop, Utilization of By-Catch from Shrimp Trawlers, Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, pp. 29-35.

James, P.S.B.R., M. Rajagopalan, S.S. Dan, A.B. Fernando and V. Selvaraj, (1989), On the mortality and stranding of marine mammals and turtles at Gahirmatha, Orissa from 1983 to 1987, Journal of the Marine Biological Association of India, 31(1 & 2): 28-35.

James, P.S.B.R., M. Rajagopalan, S.S. Dan, A.B. Fernando and V. Selvaraj, (1991), Observations on mass nesting of the olive ridley Lepidochelys olivacea at Gahirmatha, Orissa during the 1987 season, Journal of the Marine Biological Association of India, 33(1 & 2): 69-75.

Kabraji, A.M. and F. Firdous, (1984), Conservation of Turtles: Hawksbay and Sandspit, Pakistan, World Wildlife Fund Project 1451, World Wildlife Fund International and Sind Wildlife Management Board, Karachi, v + 52 pp.

Kaplan, R.D., (1994), The coming of anarchy, Atlantic Monthly, February 1994:44-76.

Kar, C.S. and S. Bhaskar, (1982), Status of sea turtles in the eastern Indian Ocean, in: K.A. Bjorndal (ed.), (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D. C., pp. 365-372.

Kelleher, V. and A. Mussa, (1995), Retention of by-catch for human consumption: The Mozambique experience, in: F. Teutscher (technical secretary), Report and Proceedings, TCDC Workshop, Utilization of By-Catch from Shrimp Trawlers, Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, pp. 60-69.

Kendall, D., (1989), Fishing characteristics of the Morrison soft TED, in: S.A. Eckert, K.L. Eckert and T.H. Richardson (compilers), Proceedings of the Ninth Annual Workshop on Sea Turtle Conservation and Biology, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NMFS-SEFC-232, pp. 77-79.

Kennelly, S.J. and M.K. Broadhurst, (1995), Fishermen and scientists solving bycatch problems: Examples from Australia and possibilities for the northeastern Unites States, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, pp. 121-128.

Kent, G., (1980), Waste and malnutrition at sea, Food Monitor, 17:4-8.

Kent, G., (1983), The pattern of fish trade, ICLARM Newsletter, April 1983, pp. 12-13.

Kent, G., (1984), National fishery policies and the alleviation of malnutrition in the Philippines and Thailand, FAO Fisheries Circular No.777FIIU/C777, United Nations Development Programme, Food and Agriculture Organization, Rome, v + 31 pp.

Kent, G., (1985), Fisheries and undernutrition, Ecology of Food and Nutrition, 46:281-294.

Kent, G., (1986), The industrialization of fisheries, Peasant Studies, 13(2):133-143.

Kent, G., (1987), Fish and nutrition in India, Food Policy, 12(2):161-175.

Kent, G., (1989), Overselling fisheries trade: The European Community and the Third World, Unpublished manuscript, 16 + 2 pp.

Kent, G., (1994), Fisheries, nutrition, and nutrition rights, Unpublished manuscript, 21 pp.

King, F.W., (1982), Historical review of the decline of the green turtle and the hawksbill, K.A. Bjorndal (ed.), (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D. C., pp. 183-188.

Klima, E., M. Renauld and G. Gitschlang, (1989), Evaluation of commercial use of TEDs, in: S.A. Eckert, K.L. Eckert and T.H. Richardson (compilers), Proceedings of the Ninth Annual Workshop on Sea Turtle Conservation and Biology, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NMFS-SEFC-232, p. 81.

Klima, E., G. Gitschlang and M. Renauld, (1992), Evaluation of commercial use of turtle excluder devices (TEDs) in the Gulf of Mexico and South Atlantic, in: Salmon, M. and J. Wyneken (compilers), Proceedings of the Eleventh Annual Workshop on Sea Turtle Biology and Conservation, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NOAA Tec. Mem. NMFS-SEFSC-302, p. 68.

Kungsuwan, A., (1995), Utilization of by-catch from shrimp trawlers in Thailand, in: F. Teutscher (technical secretary), Report and Proceedings, TCDC Workshop, Utilization of By-Catch from Shrimp Trawlers, Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, pp. 87-94.

Kungsuwan, A., (1996), Regulations, practices and statistics with regard to by-catch in the shrimp industries in Thailand, Paper prepared for FAO (55.08FT), 13 pp.

Laist, D.W., (1995), Marine debris entanglement and ghost fishing: A cryptic and significant type of bycatch? in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, pp. 33-39.

Leh, C.M.U., (1989), The green turtle, Chelonia mydas (L.) in Sarawak: Is there a future? in: S.M. Phang, A. Sasekumar and S. Vickineswary (eds.), Proceedings 12th Annual Seminar of the Malaysian Society of Marine Seciences, Kuala Lumpur, Malaysia: 219-227.

Lekagul, B., and D. Daman, (1977), Sea turtles, Conservation News (Assoc. Cons. Wild., Bangkok), 1977:5.

Leong, T.S. and K.T. Siow, (1980), Sea turtles in the east coast of Peninsular Malaysia and their economic importance, in: T.E. Chua and J.K. Charles (eds.), Coastal Resources of East Coast Peninsular Malaysia, Universiti Sains Malaysia, pp. 319-346 (cited by E.H. Chan and H.C. Liew, (1996b), Decline of the leatherback population in Terengganu, Malaysia, 1956-1995, Chelonian Conservation and Biology, 2(2):196).

Lieveld, R., (1995), Utilization of shrimp by-catch in Suriname, in: F. Teutscher (technical secretary), Report and Proceedings, TCDC Workshop, Utilization of By-Catch from Shrimp Trawlers, Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, pp. 77-80.

Liew, H.C., in press, Country Report for Malaysia, Proceedings of the Northern Indian Ocean Sea Turtle Workshop and Strategic Planning Session, Bhubaneshwar, Orissa, India, 13-18 January 1997.

Liew, H.C., E.H. Chan, F. Papi and P. Luschi, (1995a), Long distance migration of green turtles from Redang Island: The need for regional cooperation in sea turtle conservation, in: B. Devaux (technical director), Proceedings International Congress of Chelonian Conservation, Gonfaron, France, Editions SOPTOM, pp. 73-75.

Liew, H.C., E.H. Chan, P. Luschi and F. Papi, (1995), Satellite tracking data on Malaysian green turtle migration, Rend. Fis. Acc. Lincei, 9 (6): 239-246.

Limpus, C.J., (1982), The status of Australian sea turtle populations, in: K.A. Bjorndal (ed.), (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C., pp. 297-303.

Limpus, C.J., (1994), Current declines in South East Asian turtle populations, in: B.A. Schroeder and B.E. Witherington (compilers), Proceedings of the Thirteenth Annual Symposium on Sea Turtle Biology and Conservation, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NMFS-SEFSC-341, pp. 89-92.

Limpus, C.J. (1995), Global overview of the status of marine turtles: A 1995 viewpoint, in: K.A. Bjorndal (ed.), (1995), Biology and Conservation of Sea Turtles (revised edition), Smithsonian Institution Press, Washington, D.C., pp. 605-609.

Limpus, C.J. and N. Nicholls, (1988), The southern oscillation regulates the annual numbers of green turtles (Chelonia mydas) breeding around northern Australia, Australian Journal Wildlife Research, 15:157-161.

Limpus, C.J. and D. Reimer, (1994), The loggerhead turtle, Caretta caretta, in Queensland: a population in decline, in: R. James (compiler), Proceedings of the Australian Marine Turtle Conservation Workshop, Queensland Department of Environment and Heritage and Australian Nature Conservation Agency, Canbera, pp. 39-59.

Ludwig, D., R. Hilborn, and C. Walters, (1993), Uncertainty, resource exploitation, and conservation: Lessons from history, Science, 260:17, 36.

Lutcavage, M.E. and P.L. Lutz, (1991), Voluntary diving metabolism and ventilation in the loggerhead sea turtle, Journal of Experimental Marine Biology and Ecology, 147:287-296.

Lutcavage, M.E., P. Plotkin, B. Witherington and P.L. Lutz, (1997), Human impacts on sea turtle survival, in: P.L. Lutz and J.A. Musick (eds.), The Biology of Sea Turtles, CRC Press, New York, pp. 387-409.

Manger, V. and R. Chapman, (1996), The status of marine turtle conservation in Mauritius, in: S.L. Humphrey and R.V. Salm (eds.), Status of sea turtle conservation in the western Indian Ocean, Regional Seas Reports and Studies, UNEP, Nairobi, Kenya, No. 165, pp. 121-124.

Marcano, L.A. and J.J. Alio M., (1994), Impacto de la pesca de arrastre sobre las poplaciones de tortugas marinas en la region oriental de Venezuela, Informe Técnico FONAIAP, Cumaná, Venezuela, 8 pp.

Marcovaldi, M.A. and A. Filippini, (1991), Trans-Atlantic Movement by a juvenile hawksbill turtle, Marine Turtle Newsletter, 59:3.

Matchima Chanswangpuwana, (1996), Small trawlers blamed for sea turtle losses, Thai newspaper, 11 March 1996.

Mathew, S., (1990), Fishing Legislation and Gear Conflicts in Asian Countries, SAMUDRA, International Collective in Support of Fishworkers, Madras, India, No. 1, 124 pp.

McGoodwin, J.R., (1990), Crisis in the World's Fisheries: People, Problems, and Politics, Stanford University Press, Stanford, California, ix + 235.

Meylan, A., (1982a), Sea turtle migration - evidence from tag returns, in: K.A. Bjorndal (ed.), (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C., pp. 91-100.

Meylan, A., (1982b), Estimating population size in sea turtles, in: K.A. Bjorndal (ed.), (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C., pp. 135-138.

Meylan, A., et al, in prep, Status of the Caribbean Hawksbill, IUCN/SSC.

Mgawe, Y., (1995), Recent positive and negative experiences in Tanzania with regard to utilization of shrimp by-catch, in: F. Teutscher (technical secretary), Report and Proceedings, TCDC Workshop, Utilization of ByCatch from Shrimp Trawlers, Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, Rome, pp. 81-88.

Miller, J.D., (1997), Reproduction in sea turtles, in: P.L. Lutz and J.A. Musick (eds.), The Biology of Sea Turtles,CRC Press, New York, pp. 51-81.

Milne, R.S. and D.K. Mauzy, (1986), Malaysia: Tradition, Modernity, and Islam, Westview Press, London.

Mishra, A., (1997), Coast a graveyard for Ridley, dolphin, The Asian Age, 29 March 1997.

Mitchell, J.F., (1991), Turtle excluder device(TED) technology transfer to Latin American shrimp fisheries, Marine Turtle Newsletter, 56:5-7.

Mitchell, R.R. Lohoefener and J. Watson, (1989), A method for evaluating the exclusion of juvenile sea turtles from turtle excluder devices (TEDs), in: S.A. Eckert, K.L. Eckert and T.H. Richardson (compilers), Proceedings of the Ninth Annual Workshop on Sea Turtle Conservation and Biology, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NMFS-SEFC-232, pp. 115-117.

Mitchell, J.F., J.W. Watson, W.R. Seidel and A K. Shah, (1990), An alternative protocol for the qualification of new turtle excluder devices (TEDs), in: T.H. Richardson, J.I. Richardson and M. Donnelly (compilers), Proceedings of the Tenth Annual Symposium on Sea Turtle Biology and Conservation, U.S. Department of Commerce; National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NMFS-SEFSC-278, pp. 47-50.

Mohanty-Hejmadi, P. and G. Sahoo, (1994), Biology of the olive ridleys of Gahirmatha, Orissa, India, in: K.A. Bjorndal, A.B. Bolten, D.A. Johnson and P.J. Eliazar (compilers), (1994), Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NMFS-SEFSC-351, xiv + 306 pp + appendix II.

Mohanty-Hejmadi, P. (Chair), (1996), Sea turtles, in: D. Obura, A. Hangakoon, H. Jayewardene and G. Stone (eds.), Integrating Marine Conservation in the Indian Ocean: 1996 and Beyond, Summary and Working Group Reports, 28 November- 1 December 1995, Mombasa, Kenya, Indian Icean Conservation Program, pp. 21-24.

Mortimer, J. A., (1990), Marine turtle conservation in Malaysia, in: T.H. Richardson, J.I. Richardson and M. Donnelly (compilers), Proceedings of the Tenth Annual Symposium on Sea Turtle Biology and Conservation, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NMFS-SEFSC-278, pp. 21-24.

Mortimer, J.A., (1995), Headstarting as a management tool, in: K.A. Bjorndal (ed.), (1995), Biology and Conservation of Sea Turtles (revised edition), Smithsonian Institution Press, Washington, D.C., pp. 613-615.

Mrosovsky, N., (1982), Editorial, Marine Turtle Newsletter, 22:1-2.

Murawski, S.A., (1995), Meeting the challenges of bycatch: New Rules and new tools, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, pp. 5-11.

Murphy, T.M. and S.R. Hopkins-Murphy, (1989), Sea turtle & shrimp fishing interactions: A summary and critique of relevant information, Center for Marine Conservation, Washington, D.C., iii + 52 pp.

Musick, J.A. and C.J. Limpus, (1997), Habitat utilization and migration in juvenile sea turtles, in: P.L. Lutz and J.A. Musick (eds.), The Biology of Sea Turtles, CRC Press, New York, pp. 137-163.

National Research Council, (1990), Decline of the Sea Turtles: Causes and Prevention, National Academy Press, Washington, D.C.

Nakahara, J. and R.A. Witton, (1971), Developent and conflict in Thailand, Southeast Asia Program, Department of Asian Studies, Cornell Univeristy, Ithaca, New York, Data Paper:80.

Nichols, S., (1989), The bycatch issue, in: D. Burrage (compiler), Proceedings of a Mississippi Sea Grant advisory service workshop, 12 April 1989, Mississippi State University, Division of Agriculture, Forestry and Veterinary Medicine, Department of Information Services, pp. 40-45.

Norse, E.A., (1997a), Bottom trawling: The unseen worldwide plowing of the seabed, Scientific Newsletter from New England Biolabs 8(2):8-9.

Norse, E.A., (1997b), Troubled Waters: A Call for Action, Marine Conservation Biology Institute, Redmond, Washington, 11 pp.

Olguin P., José Gabriel, (1996), Análisis de los Dipositivos Excluidores de Tortugas (DET) Tipo Morrison y su impacto sobre las Capturas de la flota Camaronera de Ciudad del Carmen, Campeche, Unpublished Masters degree thesis, Departamento de Recursos del Mar, Centro de Investigaciones y de Estudios Avanzados del IPN, Unidad Mérida.

Olguin P., G.J. Frazier and J.C. Seijo (1996), The impact of TEDs on the shrimp fishery in Campeche, Mexico, in: J.A. Keinath, D.E. Barnard, J.A. Musick and B A. Bell (compilers), Proceedings of the Fifteenth Annual Symposium on Sea Turtle Biology and Conservation. U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NMFS-SEFSC-388, pp. 226-229.

Olsen, V.J., (1995), Ways in which Norway is solving the bycatch problem, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, 289-291.

Oravetz, C.A., (1984), Trawling efficiency device (TED) technology transfer program, Marine Turtle Newsletter, 27:6-7.

Oravetz, C.A., (1988), Status of federal regulations to reduce the incidental capture and mortality of sea turtles from shrimp trawling, in: B.A. Schroeder (compiler), Proceedings of the Eighth Annual Workshop on Sea Turtle Biology and Conservation, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NOAA Tec. Mem. NMFS-SEFC-214, pp. 75-77.

Oravetz, C.A., (1992), The status of revisions to the TED regulations and implementation of Public Law 101-162 (the sea turtle conservation/shrimp embargo bill), in: Salmon, M. and J. Wyneken (compilers), Proceedings of the Eleventh Annual Workshop on Sea Turtle Biology and Conservation, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NOAA Tec. Mem. NMFS-SEFSC-302, pp. 87-89.

Oravetz, C.A., and C.J. Grant, (1986), Trawl efficiency device shows promise, Australian Fisheries. February, 37-40.

O'Riordan, B., (1994), Tangled webs of chaos adrift, New Scientist, 20 August 1994, 1939:44-45.

Oruç, A.F. Demirayak and G. Sat, (1997), Trawl fisheries in the eastern Mediterranean and it's impact on sea turtles, The Society for the Protection of Nature, Istanbul, Turkey, 30 pp.

Paine, B.C. and J. Gruver, (1995), Bycatch reduction: Achieving new objectives by innovative footrope and net configuration, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, p. 87.

Panda, P., (1997), Dash urges new plan to save turtles, Asian Age, 10 November 1997.

Pandav, B., B.C. Choudhury and C.S. Kar, (1997), Olive Ridley Sea Turtle (Lepidochelys olivacea) and its Nesting Habitats Along the Orissa Coast, India: A Status Survey (revised edition), Wildlife Insitute of India, Dehra Dun, (iv) + 48 pp.

Papi, F., H.C. Liew, P. Luschi and E.H. Chan, (1995), Long-range migratory travel of a green turtle tracked by satellite: Evidence of navigational ability in the open sea, Marine Biology, 12:171-175.

Pauly, D., (1988), Fisheries research and the demersal fisheries of southeast Asia, in: J.A. Gulland (ed.), Fish Population Dynamics, John Wiley & Sons Ltd.; London, pp. 329-348.

Pauly, D., (1995), Fleet-operational, economic, and cultural determinants of bycatch uses in Southeast Asia, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, pp. 285-288.

Pauly, D. and Chua Thia Eng, (1988), The overfishing of marine resources: Socioeconomic background in southeast Asia, Ambio, 17(3):200-206.

Pauly D. and R. Neal, (1985), Shrimp vs. Fish in Southeast Asian fisheries: The biological, technological and social problems, in: Recursos Pesqueros Potenciales de México: La Pesca Acompañante del Camarón. Programa Universitario de Alimentos, Instituto de Ciencias del Mar y Limnología, Insituto Nacional de la Pesca, UNAM, México, D.F., pp. 487-510.

Phasuk, B., (1982), Sea turtle conservation in Thailand, Thai Fish, Gaz, 35(2):171-177.

Phillips, H.P., (1965), Thai Peasant Personality: The Patterning of Interpersonal Behavior in the Village of Bang Chan, University of California Press, Berkeley.

Pillai, N.S., (1995), On-going research activities on selective shrimp trawling in India. in: J. Prado and F.A. Rahman (eds.), FAO/INFOFISH/SEAFDEC, Workshop on Research in the Selectivity of Fishing Gear and Methods in South East Asia and Selective Shrimp Fishing, Chendering, Malaysia, 28-30 May 1995, FAO Fisheries Circular No. 902, Food and Agriculture Organization of the United Nations, Rome, pp. 13-15.

Pitman, R.L., (1990), Pelagic distribution and biology of sea turtles in the eastern tropical Pacific, in: T.H. Richardson, J.I. Richardson and M. Donnelly (compilers), Proceedings of the Tenth Annual Workshop on Sea Turtle Biology and Conservation, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, NOAA Tec. Mem. NMFS-SEFC-278, pp. 143-148.

Plotkin, P.T., R.A. Byles, D.C. Rostal and D.W. Owens, (1995), Independent versus socially facilitated oceanic migrations of the olive ridley, Lepidochelys olivacea, Marine Biology 122:137-143.

Plotkin, P.T., D.C. Rostal, R.A. Byles and D.W. Owens, (1997), Reproductive and developmental synchrony in female, Lepidochelys olivacea, Journal of Herpetology 31(1):17-22.

Poiner, I. and A. Harris, (1994), The incidental capture and mortality of sea turtles in Australia's northern prawn fishery, in: R. James (compiler), Proceedings of the Australian Marine Turtle Conservation Workshop, Queensland Department of Environment and Heritage and Australian Nature Conservation Agency, Canbera, pp. 127-135.

Polunin, N.V.C. and N.S. Nuitja, (1982), Sea turtle populations of Indonesia and Thailand, in: K.A. Bjorndal (ed.), (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C., pp. 353-362.

Prado, J., (1992), List of references on the selectivity of various fishing gears and methods: Research in this field, FAO Fisheries Circular No. 850, Food and Agriculture Organization of the United Nations, Rome, iii + 150 pp.

Prado, J., (1997), Technical measures for bycatch reduction, in: I.J. Clucas and D.G. James (eds.), (1997), Papers presented at the technical consultation on Reduction of Wastage in Fisheries, Tokyo, Japan, 28 October-1 November 1996, FAO Fisheries Report, No. 547, Supplement, Rome, FAO, pp. 25-44.

Prado, J. and F.A. Rahman, (1995), FAO/INFOFISH/SEAFDEC, Workshop on Research in the Selectivity of Fishing Gear and Methods in South East Asia and Selective Shrimp Fishing, Chendering, Malaysia, 28-30 May 1995, FAO Fisheries Circular No. 902, Food and Agriculture Organization of the United Nations, Rome, iii + 29 pp.

Prado, J. and F.A. Rahman, (1996), FAO/China Society of Fisheries Experts and Industry, Consultation on Selective Fishing for Responsible Exploitation of the Marine Resources in Asia, Bejing, China, 12-17 October 1995, FAO Fisheries Report No. 545, Food and Agriculture Organization of the United Nations, Rome, v + 24 pp.

Pritchard, P.C.H. and R. Marquéz M., (1973), Kemp's ridley turtle or Atlantic ridley Lepidochelys kempi, IUCN Monograph, Marine Turtle Series No. 2, Morges, Switzerland, 30 pp.

Pritchard, P.C.H. and P. Trebbau, (1984), The Turtles of Venezuela, Society for the Study of Amphibians and Reptiles, 404 pp.

Pultz, S., D. O'Daniel, S. Krueger, H. McSharry and G. Balazs, (submitted), Marine turtle study on the Island of Tinian, Commonwealth of the North Mariana Islands, Micronesia.

Quarto, A., (1992), Fishers among the mangroves, Cultural Survival Quarterly, Winter 1992, pp. 12-15.

Rai, S., (1997), Trawlers leave a trail of turtles' death, Hindustan Times, 10 February 1997.

Renaud, M., G. Gitschlag, E. Klima, A. Shah, D. Koi and J. Nance, (1993), Loss of shrimp by turtle excluder devices (TEDs) in coastal waters of the United States, North Carolina to Texas: March 1988- August 1990, Fisheries Bulletin, 91:129-137.

Robins, J.B., (1995), Estimated catch and mortality of sea turtles from the east coast otter trawl fishery of Queensland, Australia, Biological Conservation, 75:157-167.

Robins-Troeger, J.B., R.C. Buckworth and M.C.L. Dredge, (1995), Development of a trawl efficiency device (TED) for Australian prawn fisheries, II Field evaluations of the AusTED, Fisheries Research, 22:107-117.

Robins, J.B., R.C. Buckworth, R.P. Mounsey and M.C.L. Dredge, (1997), Development and application of AusTED in the Australian Trawl Industry, Queensland Department of Primary Industries, Fisheries research & Development Corporation, Project No. 93/231.07 53, pp. + IV Appendices.

Romine, T., Perspectives on the global fisheries crisis, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tomorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, pp. 61-69.

Ross, J.P., (1982), Historical decline of loggerhead, ridley, and leatherback sea turtles, in: K.A. Bjorndal (ed.), (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C., pp. 189-195.

SAMUDRA, (1994), The Cebu Conference, Proceedings, International Collective in Support of Fishworkers, Madras, India, 346 pp.

Sarker, H.S., P. Mohanty-Hejmadi, W.R. Seidel, H. Lingham, K.P. Philip, C. Behera, R.S. Mishra, J. Ramesh, T.K. Patnaik, (1996), Recommendations of the training-cum-demonstration workshop on turtle excluder device

(TED) held at Paradeep, Orissa, from 11-14 November 1996, Department of Fisheries, Government of Orissa & Project Swarajya, Cuttack, Orissa, 8 pp.

SEAFDEC, (1996), TED gained Thai fishermen's acceptance, SEAFDEC Newsletter July-September, pp. 11, 15.

SEAFDEC, (1997a), Workshop on TED in Malaysia, SEAFDEC Newsletter January-March 20(1):10

SEAFDEC, (1997b), TED research in Malaysia proves another theory, SEAFDEC Newsletter January-March 20(1).

SEAFDEC, (1997c), TD promotes TED's in the region, SEAFDEC World Wide Web page.

Seidel, W.R. and C. McVae, R., (1982), Development of a sea turtle excluder shrimp trawl for the southeast U.S. penaeid shrimp fishery, in: K.A. Bjorndal (ed.), (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C., pp. 497-502.

Settle, S., (1995), Status of nesting populations of sea turtles in Thailand and their conservation, Marine Turtle Newsletter, 68:8-13.

Shaver, D.J., (1994), Sea turtle strandings along the Texas coast reach alarming levels, Marine Turtle Newsletter, 66:8-9.

Shaver, D.J., (1995), Sea turtle strandings along the Texas coast again cause concern, Marine Turtle Newsletter, 70:2-4.

Sierra Club Legal Defense Fund, (1997), Statement of Scientists, 12 pp.

Silas, E.G., (1984), Observations on turtles at sea and in the Lakshadweep, Central Marine Fisheries Researcy Institute Bulletin 35:59-61.

Silas, E.G., M. Rajagopalan and A. Bastian Fernando, (1983a), Sea turtles of India - Need for a crash programme on conservation and effective management of the resource, Marine Fisheries Information Service, (Special issue on management and conservation: Sea Turtles), 50:1-12.

Silas, E.G., M. Rajagopalan, A. Bastian Fernando and S.S. Dan, (1983b), Marine turtle conservation and management: A survey of the situation in Orissa 1981/82 and 1982/83, Marine Fisheries Information Service, (Special issue on management and conservation Sea Turtles), 50:13-23.

Silas, E.G., M. Rajagopalan and S.S. Dan, (1983c), Marine turtle conservation and management: A survey of the situation in West Bengal 1981/82 and 1982/83, Marine Fisheries Information Service, (Special issue on management and conservation Sea Turtles), 50:54-32.

Silas, E.G., M. Rajagopalan, S.S. Dan and A. Bastian Fernando, (1984), Observations on the mass nesting and immediate postmass nesting influxes of the olive ridley Lepidochelys olivacea at Gahirmatha, Orissa-1984 season, Central Marine Fisheries Researcy Institute Bulletin 35:76-82.

Silas, E.G., M. Rajagopalan, S.S. Dan and A. Bastian Fernando, (1985), On the large and mini arribadas of the olive ridley Lepidochelys olivacea at Gahirmatha, Orissa during the 1985 season, Marine Fisheries Information Service, 64:1-19.

Siow K.T. and E.O. Moll, (1982), Status and conservation of estuarine and sea turtles in West Malaysian waters, in: K.A. Bjorndal (ed.), (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C., pp. 339-347.

Smith, A.R., (1997), Selectivity in its wider context, in: I.J. Clucas and D.G. James (eds.), (1997) Papers presented at the technical consultation on Reduction of Wastage in Fisheries, Tokyo, Japan, 28 October-1 November 1996, FAO Fisheries Report, No. 547, Supplement. Rome, FAO, pp. 15-23.

Smith, T.P., (1995), Solving the bycatch problem: An economic perspecive, in: T. Wray (technical editor), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, pp. 53-59.

Spring, C.S., (1982), Status of marine turtle populations in Papua New Guinea, in: K.A. Bjorndal (ed.), (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C., pp. 281-291.

Sridhar, V., (1997a), Threatened habitat: Olive ridley turtles on the Orissa coast need protection, Frontline (New Delhi), 16 May 1997, pp. 66-69.

Sridhar, V., (1997b), Tracking the olive ridley, Frontline (New Delhi), 16 May 1997, pp. 70-71.

Stabenau, E.K., T.A. Heming and J F. Mitchell, (1991), Respiratory, acid-base and ionic status of Kemp's ridley sea turtles (Lepidochelys kempi) subjected to trawling, Comparative biochemistry and Physiology 99A, No. 1/2:107-111.

Stancyk, S.E., (1982), Non-human predators of sea turtles and their control, in: K.A. Bjorndal (ed.), (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C., pp. 139-152.

Steiner, T., (1994), Shrimpers implicated as strandings soar in USA, Marine Turtle Newsletter, 67:2-5.

Stuart, E. and M. Cartin, (1994), Conservation of sea turtles at two national parks on the Andaman sea coast of Thailand, Marine Turtle Newsletter, 67:6-8.

Suliansa, M.S., P. Basintal and N.L. Chan, (1996), Impacts of fishery related activities on sea turtles, Paper presented at the National Seminar/Workshop on Marine Turtles and Terrapin Management, 22-23 October 1996, Cherating, Malaysia, 6 pp.

Supot C., (1997), Status of marine turtles in Thailand, Country Report presented at Northern Indian Ocean Workshop on Sea Turtles, Bhubaneshwar, India, January 1997.

Teutscher, F., (technical secretary), (1995a), Report and Proceedings, TCDC Worksh, Utilization of By-Catch from Shrimp Trawlers, Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, 97 pp.

Teutscher, F., (1995b), By-catch in tropical shrimp fisheries, in: F. Teutscher (technical secretary), Report and Proceedings, TCDC Workshop, Utilization of By-Catch from Shrimp Trawlers, Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, pp. 11-18.

TEWG (Turtle Expert Working Group), (1996), Kemp's ridley sea turtle (Lepidochelys kempii) status report, 28 June 1996, Unpublished manuscript, (deposited at Center for Marine Conservation, Washington, D.C.), 49 pp.

Tucker, A.D., J.B. Robins and D.P. McPhee, (1997), Adopting turtle excluder devices in Australia and the United States: What are the differences in technology transfer, promotion, and acceptance? Coastal Management, 25:405-421.

Tuoc, P., (1985), Shrimp resource and reasonable utilization of by-catch from shrimp trawlers, in: F. Teutscher (technical secretary), Report and Proceedings, TCDC Workshop, Utilization of By-Catch from Shrimp Trawlers, Nose Bé, Madagascar, 6-8 June 1995, Government of Madagascar, United Nations Development Programme, Food and Agriculture Organization, pp. 95-97.

Utting, P., (project co-ordinator), (1995), States in Disarray: The Social Effects of Globalization, United Nations Research Institute for Social Development (UNRISD) and Banson, Geneva & London, 172 pp.

Van Buskirk, J. and L. B. Crowder, (1994), Life-history variation in marine turtles, Copeia, 1994:66-81.

Walakkamon Lamwitwatkit, (1996), Trawlers are behind sea turtle decline, The Nation (Bangkok), 13 March 1996.

Wamukoya, G.M., F. Kaloki and C. Mbindo, (1996), The status of sea turtle conservation in Kenya, in: S.L. Humphrey and R.V. Salm (eds.), Status of sea turtle conservation in the western Indian Ocean, Regional Seas Reports and Studies, UNEP, Nairobi, Kenya, No. 165, pp. 57-72.

Watson, J.W. and W.R. Seidel, (1980), Evaluation of techniques to decrease sea turtle mortalities in the southeastern United States shrimp fishery, International Council for Exploration of the Seas, C.M., B 31:1-8.

Weber, M., D. Crouse, R. Irvin and S. Iudicello, (1995), Delay and Denial: A political history of sea turtles and shrimp fishing, Center for Marine Conservation, Washington, D.C., 46 pp.

West, B., (1995), Turtle turmoil in India, Earth Island Journal, Spring 1995, p. 8.

Witzell, W.N., (1994), The origin, evolution and demise of the U.S. Sea Turtle Fisheries, Marine Fisheries Review, 56(4):8-23.

World Bank, (1997), World Development Indicators, The World Bank, Washington, D.C.

World Conference on Sea Turtle Conservation, (1982), Sea turtle conservation strategy, Action plan for the conservation of sea turtles, Action projects, in: K.A. Bjorndal (ed.), (1982), Biology and Conservation of Sea Turtles, Smithsonian Institution Press, Washington, D.C., pp. 567-583.

Wray, T., (technical editor), (1995), Solving Bycatch: Considerations for Today and Tommorrow, University of Alaska Sea Grant College Program, Fairbanks, Alaska, ix + 322 pp.

Wright, A., (1984), Letter to Shri. J. B. Patnaik, Hon'ble Chief Minister of Orissa, 2 pp.

Wyneken, J., (1997), Resolutions of the 17th Annual Symposium on Sea Turtles Biology and Conservation, 4-8 March 1997, Orlando, Florida, USA, 9 pp.

Yamamoto, T., (1994), Fishing rights and licences, A new fishery law may help, SAMUDRA 10 & 11:29-30.

Cited by Mr. M. Guinea:

Broderick et. al., (1994), Genetic Studies of the Hawksbill Turtle Eretmochelys Imbricata: Evidence for Multiple Stocks in Australian Waters, Pacific Conservation Biology, Vol. 1 No. 2, p. 123-131.

Carr, A., (1973), So Excellent a Fish, Anchor Press.

Chaloupka, M.Y. and Musick, J.A., (1997), Age, Growth and Population Dynamics, in: Lutz, P.L. and J.A. Musick (ed.), The Biology of Sea Turtles. CRC Press pp 234-276.

Chan, E.H., H.C. Liew and A.G. Mazlan, (1987), The Incidental Capture of Sea Turtles in Fishing Gear in Terengganu, Malaysia, Biological Conservation, 1-7.

Chatto, R., M. Guinea and S. Conway, (1995), Sea Turtles Killed by Flotsam in Northern Australia, Marine Turtle Newsletter, 69:17-8.

Chokesanguan, B., Y. Theparoonrat, S. Ananpongsuk, A. Siriraksophon, L. Podapol, P. Aosomboon, and A. Ali, (1996), The Experiments on Turtle Excluder Devices (TEDs) for Shrimp Trawl Nets in Thailand.

Crouse, D.T., L.B. Crowder, H. Caswell, (1987), A Stage-Based Model for Loggerhead Sea Turtles and Implications for Conservation, Ecology, 68(5):1412-1423.

Davis, T.A. and Bedi, R., (1978), Mass Slaughter of Sea Turtles, Hamadryad, p. 8.

Eckert, S.A. and Sarti, L., (1997), Distant Fisheries Implicated in the Loss of the World's Largest Leatherback Nesting Population, Marine Turtle Newsletter, 78:2-7.

Frazier, J., (1980), Exploitation of Marine Turtles in the Indian Ocean, Human Ecology, 8(4):329-370,.

Grand, J. and Beissinger, S.R., (1997), When Relocation of Loggerhead Sea Turtle (Caretta Caretta) Nests Becomes a Useful Strategy, Journal of Herpetology, 31(3):428-434.

Guinea, M.L. and Chatto, R., (1992), Sea Turtles Killed in Australian Shark Fin Fishery, Marine Turtle Newsletter, 57:5-6.

Guinea, M.L., (1993), The Sea Turtles of Fiji, SPREP Reports and Studies Series, No. 65.

Heppell et. al., (1996), Population Model Analysis for the Loggerhead Sea Turtle Caretta Caretta, in Queensland, Wildlife Research, 23:143-59.

IUCN (World Conservation Union), (1995), Integrating Marine Conservation in the Indian Ocean: 1996 and Beyond, Summary and Working Group Reports, November 28-December 1, 1995, Mombasa, Kenya.

IUCN/SSC Marine Turtle Specialist Group, (1995a), A Global Strategy for the Conservation of Marine Turtles.

Johannes, R E. and MacFarlane, J.W., (1991), Traditional Fishing in the Torres Strait Islands, pp. 53-71, CSIRO Division of Fisheries.

Kar, C.S. and Bhaskar, S., (1992), Status of Sea Turtles in the Eastern Indian Ocean, in Biology and Conservation of Sea Turtles, K.A. Bjorndal ed.

Liew H.-C., (1997), Marine Turtle Research and Management in Malaysia, in: Proceedings of Workshop on Marine Turtle Research and Management in Indonesia, Jember, East Java, November 1996, pp. 101-110.

Limpus, C.J., (1997), Marine Turtle populations of Southeast Asia and the Western Pacific Region: Distribution and Status, in: Proceedings of the Workshop on Marine Turtle Research and Management in Indonesia, Jember, East Java, November 1996, pp. 37- 72.

Limpus, C.J., (1997a), The Marine Turtle Life Cycle, in Proceedings of the Workshop on Marine Turtle Research and Management in Indonesia, Jember, East Java, Indonesia, November 1996, pp. 185-6.

Limpus, C.J. and Reed, P.C., (1985), Green Sea Trutles Stranded by Cyclone Kathy on the South-Western Coast of the Gulf of Carpentaria, Aust Wildl. Res., 12:523-33.

Lohmann, K.J., B.E. Witherington, C.M.F. Lohmann and M. Solomon, (1997), Orientation, Navigation, and Natal Beach Homing in Sea Turtles, in: Lutz, P.L. and J.A. Musick, The Biology of Sea Turtles, CRC Press.

Lutcavage, M.E., P. Plotkin, B. Witherington, and P.L. Lutz, (1997), Human Impacts on Sea Turtle Survival, in: P.L. Lutz and J.A. Musick (ed.), The Biology of Sea Turtles, pp. 387-409.

Marine Turtle Newsletter, Hurricane Pauline Destroyed 40 Million Sea Turtle Eggs in the Oaxacan Beach of Mazunte, (1997), No. 78, p. 26.

Marquez, R., (1990), Sea Turtles of the World, FAO Species Catalogue, p. 48,.

Monanunsap, S., (1997), Marine Turtle Research and Management in Thailand, in: Proceedings of the Workshop on Marine Turtle Research and Management in Indonesia, Jember, East Java, November 1996, pp. 139-149.

Mortimer, J.A., (1995), Teaching Critical Concepts for the Conservation of Sea Turtles, Marine Turtle Newsletter, 71:1-4. (Attachment 30).

Mounsey, R., (1995), The Australian Trawl Efficiency Device (AusTED) in the Northern Prawn Fishery (NPF), FAO Workshop on Selective Shrimp Trawling With Selective Devices, 24-26 July 1997, Darwin NT Australia.

National Research Council, National Academy of Sciences, (1990), Decline of the Sea Turtles - Causes and Prevention.

Paterson, P., (1979), Shark Meshing Takes a Heavy Toll of Harmless Marine Animals, Australian Fisheries, 38(10):17-23.

Poiner I.R., R.C. Buckworth, and A.N. Harris, (1990), Incidental Capture and Mortality of Sea Turtles in Australia's Northern Prawn Fishery, Aust. J. Mar. Freshwater Res. 41:97-110.

Pritchard, P., (1997), Evolution, Phylogeny and Current Status, in: P.L. Lutz and J.A. Musick (ed.), The Biology of Sea Turtles, p. 16.

Robins, J. and Campbell M., (1997), History of BRD Development in Australia, FAO Workshop on Selective Shrimp Trawling With Selective Devices, 24-26 July 1997, Darwin NT Australia.

Robins, J., (1995), Estimated Catch and Mortality of Sea Turtles From the East Coast Otter Trawl Fishery of Queensland, Australia, Biological Conservation, 74:157-167.

Sachse, M. and Wallner, B., (in press), Marine Turtle Bycatch in the Northern Prawn Fishery - Scale of the Problem and Developing Solutions, in: Proceedings of the Workshop on Marine Turtle Conservation and Management in Northern Australia, 3-4 June 1997.

Satapathy Rajaram, The Times of India News Service, per Frazier J., 17 November 1997.

Stanley W., (1996), US Net Ban to Prawn Industry, Northern Territory News, May 6, 1996.

Steiner, T., (1994), International Implementation of TEDs Law, PL. 101-162, by the U.S. Government: Fact or Science Fiction, Proceedings of the Thirteenth Annual Symposium on Sea Turtle Biology and Conservation, NOAA, Technical Memorandum, NMFS -SEFSC-341: pp. 171-181.

The Status of Major Sea Turtle Populations in Malaysia, (http://www.upmt.edu.my/seatru/mals3.htm),.

Threats to Sea Turtles, (http://www.opmt.edu.my/seatru/cons2.htm).

Travis, W., (1967), The Voice of the Turtle, George Allen and Unwin, London.

Verbal presentation by India at FAO Responsible Fishing Workshop Darwin, NT, Australia, 24-26 July 1997.

WWF, Marine Turtles of Pakistan.

Cited by Mr. H.-C. Liew:

M. Coyne, (16-06-97), Some good and bad news for Kemp's, CTURTLE List (Internet Source).

D. Crouse, (20-05-96), TEDs Action Alert, CTURTLE List (Internet Source).

Limpus C.J., (1997), Marine Turtle Populations of Southeast Asia and the Western Pacific Region: Distribution and Status, Yus R. N., R.L. Irwansyah, R. Ounsted, S. Troeng and A. Abdullah (eds). Proc. Of the Workshop on Marine Turtle research and Management in Indonesia, Jember, East Java. Nov. 1996, Wetlands International/PHPA/Environment Australia, Bogor.:37-73.

T. Steiner, (29-07-97), Are TEDs coming off, CTURTLE List (Internet Source).

T. Steiner, (19-11-97), Re: Kemp's at Rancho Nuevo, CTURTLE List (Internet Source).

Suliansa M.S., P. Basintal and N.L. Chan, (in press), Impacts of Fishery Related Activities on Sea Turtles, Paper presented at the National Seminar/Workshop on Marine Turtle and Terrapin Management, 22-23 October 1996, Cherating, Malaysia.

Cited by Dr. I. Poiner:

Anonymous, (1997), Interim Advice to the Minister for the Environment from the Endangered Species Scientific Subcommittee (ESSS) on a Public Nomination to Schedule 3 of the Endangered Species Protection Act 1992 (ESP Act). (Note – the nomination was for the incidental catch (bycatch) of sea turtles during coastal otter-trawl fishing operations in Australian waters north of 28^0S to be declared a key threatening process of sea turtles).

Bowen, B.W., Abreu-Grobois, F.A., Blazas, G.H., Kamezaki, N., Limpus, C. and Ferk, R.J., (1995), Trans-Pacific Migrations of the Loggerhead Turtle (Caretta caretta) Demonstrated with Mitochondrial DNA Markers, Proceedings of the National Academy of Sciences, U.S.A. 92:3731.

Broderick, D., Moritz, C., Millar, J.D., Guinea, M., Prince, R.I.T. and Limpus, C., (1994), Genetic Studies of the Hawksbill Turtle, Eretmochelys imbricata: Evidence for Multiple Stocks in Australian Waters, Pacific Conservation Biology 1:123.

Brewer, D.T., Eayrs, J. and Rawlinson, N.J.F., (1995), Bycatch Reduction Devices Show Promise in the NPF, Australian Fisheries 54:24-26.

Brewer, D.T., Eayrs, J., Rawlinson, N.J.F., Salini, J.P., Farmer, M., Blaber, S.J.M., Ramm, D.C., Cartwright, I. And Poiner, I.R., (1997), Recent Advancements in Environmentally Friendly Trawl Gear Research in Australia, Proceedings of the 2nd World Fisheries Congress.

Caillouet, C.W., Shaver, D.J., Teas, W.G., Nance, J.M., Revera, D.B. and Cannon, A.C., (1995), Relationship Between Sea Turtle Stranding Rates and Shrimp Fishing Intensities in the Northwestern Gulf of Mexico: 1986-1989 versus 1990-1993, Fisheries Bulletin 94:237-249.

Chaloupka, M.Y. and Limpus, C.J. (MS), Heuristic Simulation Modelling of Trawl Fishery Impacts on Southern Great Barrier Reef Loggerhead Population Dynamics, Fisheries Bulletin.

Chaloupka, M.Y. and Musick, J.A., (1997), Age, Growth and Population Dynamics, in: The Biology of Sea Turtles, Lutz, P.L and Musick, J.A. Eds., CRC Press Boca Raton, USA, p. 233-276.

Chan, E.H., Liew, H.C. and Maslan, A.G., (1987), The Incidental Capture of Sea Turtles in Fishing Gear in Terengganu, Malaysia, Biological Conservation 43:1-7.

Chark, L.H., (1997), Country Paper - Malaysia, Proceedings of the Workshop on Marine Turtle Research and Management in Indonesia, Jember, East Java, Indonesia, November 1996, p. 101-110.

Crouse, D.T., L.B. Crowder, & H. Caswell, (1987), A Stage Based Population Model for Loggerhead Sea Turtles and Implications for Conservation, Ecology 68:1412-1423.

Crowder, L.B., Crouse, D.T., Heppell, S.S. and Martin T.H., (1994), Predicting the Impact of Turtle Excluder Devices on Loggerhead Sea Turtle Populations, Ecological Applications 4:437-445.

Henwood, T.A. and W.E. Stuntz, (1987), Analysis of Sea Turtles Captures and Mortalities During Commercial Shrimp Trawling, Fisheries Bulletin, U.S. 85:813-817.

Henwood, T.A., Stuntz, W.E. and Thompson, (1992), Evaluation of U.S. Turtle Protective Measures Under Existing TED Regulations, Including Estimates of Shrimp Trawler Related Mortality in the Wider Caribbean, NOAA Technical Memorandum NMFS-SEFSC-303.

Heppell, S.S., Limpus, C.J., Crouse, D.T., Frazer, N.B. and Crowder, L.B., (1995), Population Model Analysis for the Loggerhead sea Turtle, Caretta caretta, in Queensland, Australian Wildlife Research, 23:143-154

Limpus, C., (1997), Marine Turtle Population of South East Asia and the Western Pacific Region: Distribution and Status, Proceedings of the Workshop on Marine Turtle Research and Management in Indonesia, Jember, East Java, Indonesia, November 1996.

Lutcavage, M.E., Plotkin, P., Witherinton, B. and Lutz, P., (1997), Human impacts on sea turtle survival, in: The Biology of Sea Turtles, Lutz, P.L and Musick, J.A. Eds., CRC Press Boca Raton, USA, p. 387-409.

Monanunsap, S., (1997), Country paper - Thailand, Proceedings of the Workshop on Marine Turtle Research and Management in Indonesia. Jember, East Java, Indonesia, November 1996, p. 139-149.

Poiner, I.R. and Harris, A.N.M., (1996), Incidental Capture, Direct Mortality and Delayed Mortality of Sea Turtles in Australia's Northern Prawn Fishery, Marine Biology 125:813-825.

Robins, J.B., (1995), Estimated Catch and Mortality of Sea Turtles form the East Coast Otter Trawl Fishery of Queensland, Australia, Biological Conservation 74:157-167.

Robins-Troeger, J.B., Buckworth, R.C. and Dredge, M.C.l., (1995), Development of a Trawl Efficiency Device (TED) for Australian Prawn Fisheries. II. Field evaluations of the AusTED. Fisheries Research 22:107-117.

Settle, S., (1995), Status of Nesting Populations of Sea Turtles in Thailand and their Conservation. Marine Turtle Newsletter 68:8-13.

Somers, I., (1994), Modelling Loggerhead Turtle Populations, in: Proceedings of the Marine Turtle Conservation Workshop, James, R., Compiler, Australian National Parks and Wildlife Service, Canberra, p. 142-153.

Tucker, A.D., McPhee, D.P., and Robbins, J.B., (1997), Adopting Turtle Excluder Devices in Australia and the United States: What Are the Differences in Technology Transfer, Promotion and Acceptance? Coastal Management 25:404-421.

ANNEX IV

TRANSCRIPT OF THE MEETING WITH EXPERTS HELD ON 21 AND 22 JANUARY 1998

First day - 21 January 1998

Chairman

117. I would like to welcome the scientific experts as well as the parties to this meeting. Let me start by informing you that the proceedings are going to be recorded. Therefore, when taking the floor, representatives, experts are requested to use the microphones and to speak slowly and clearly. A transcript will be made of this meeting and it is the intention of the Panel to attach the transcript to the Panel Report as part of the record. At this stage I would like first of all to thank the experts very sincerely for the effort they have already put in and the very hard work that they have put in over a very short period of time to respond to the request from the Panel for them to give advice and to the answers to the questions that we have put to them. As you know, we are operating under very stringent time constraints and we have to produce reports within certain time frames and this puts enormous pressure on all persons involved in these proceedings. But I would like to say a special word of thanks to the experts who have come out of the blue to assist in this process.

118. The purpose of this meeting is really to allow the experts to expand on their written reports and to discuss amongst themselves in front of us for the benefit of the Panel. The documents which have been produced are very substantive and obviously its not a matter of repeating them all, but really more of highlighting the main points, commenting as appropriate on colleagues reports, so that the Panel can be as fully informed as possible regarding sea turtle conservation problems so that we can be in a better position to assess the controversial issues underlying the facts of this case.

119. Now in this regard the parties will be given an opportunity during this meeting to seek clarification regarding the reports of the experts and to express their views on them. It is not the purpose of the meeting though to hear further argumentation or new evidence which the parties did not submit by the time of the second meeting of the Panel which was held in September 1997. Similarly, we do not intend to have formal statements by the parties, the purpose of this meeting is to hear the experts and to put questions to the experts including though from scientific experts of the parties. But parties will of course be allowed to address matters raised by the experts and the Panel expects the parties to put all their questions in the context of this meeting and to seek replies from the experts within this meeting.

120. The Panel considers that by the end of the meeting tomorrow there will have been sufficient time for the parties to make all the necessary comments even if they have already missed some of the deadlines in the past, the opportunity is now to get their points across and to get answers from the experts. As I said at the beginning, this will be a recorded proceeding, so to the answers will be written and will be in the record. Therefore, the Panel does not intent to prolong the process beyond the end of this meeting tomorrow. We see this as the final point at which comments on comments and comments are going to have to come to an end but it is really an expert process that we are in rather than any sort of continuation of the previous argumentation that we heard from the parties.

121. Experts can if they want react to what has been said by the parties and priority will be given to the experts and therefore parties will be asked to limit their interventions to questions and comments related to the issues raised by the experts. The Panel will not take account of interventions outside this framework. I want to stress that the proceedings are confidential, everything which is being said in this room is subject to the rules of the Dispute Settlement Understanding and the Code of Conduct.

122. I would also like to explain how the Panel intends to proceed in actually handling this meeting today and tomorrow. We propose first to invite statements by the experts focusing on their main points, their main arguments, main areas of contention and also, if necessary, where they see problems between their own and their colleagues reports. I propose that we have that process initially in alphabetical order and after the statements to allow the experts then a second round to make comments on each others presentations and to develop the discussion and argumentation.

123. When this is concluded, the parties to the dispute will be given an opportunity to put their questions and comments and again we would want to take that in series starting with the complaining parties in the order that we established in the earlier meetings, that is to say, Thailand, India, Pakistan and Malaysia followed by the United States. After this process we would then give the floor back to each expert again to give their final statement, their responses to the parties and their conclusions. Now, that is roughly the outline of how we expect it to go, of course as the discussion develops I would expect that the Panel will wish to interject questions and the parties may also wish to develop a freer discussion as it goes along.

124. But I think we have to keep in mind the time frame which is basically this afternoon and tomorrow morning and we would hope to be in a position to conclude this meeting by the end of the morning. Bearing in mind that there are ten speakers potentially and that we will have more than one round from at least half of them, I think it would be helpful to try and keep the interventions to the point and as brief as possible. Having said that, I don't wish to limit the experts in any way in what they want to say. I think that they are well aware of the issue that is before us, the terms of reference of the Panel, they have seen all the documentation in the dispute and I think really that it should be for them to present their reports in the way that they see best. That said I would like to now give the floor to the experts in alphabetical order and that means that I start with Dr. Eckert.

Dr. Eckert

125. Thank you Mr. Chairperson. My name is Scott Eckert and my current position is a senior research biologist at the Hubbs-Sea World Research Institute. I think, as you have probably all gathered from the information that we as a group of scientist have provided to you, the issues relative to sea turtle biology are not an easy issue to understand. Those of us who have been working with turtles for many years feel like we have barely scratched the surface of what we understand about the biology of these creatures. Much of the information available today about these creatures is limited to anecdotal information or very limited reports and so if you see confusion in some of the various documents and even disagreements in some of the documents, it often comes because there is not a ready set of reference materials you can turn to out there that tells you everything you ever wanted to know about the biology of a turtle.

126. And I think in our discussion as the day progresses you will see maybe some of those distinctions may get clarified once we have had a chance to chat with each other about our various opinions. My responses to the questions and I am going to limit this presentation to a very short summary of the points I tried to point out in my particular responses. I understand later that we will have some more time for more detail and if there are issues that I can present then in more detail with backing factual information I will do so.

127. The issue as I see it, we see turtle biology today and we see turtle populations in general is that virtually all sea turtle population are in trouble. There is ample evidence to indicate that all species are in decline with the possible exception of the Australian flatback (Natator depressus) because it is an endemic species to Australia and has not had the same sort of perturbations that we have seen from other populations. But on a global level, all sea turtle populations have exhibited decline, all sea turtle species have exhibited decline in their population to the point where we need to be worried about them. In a general sense, most of the problems faced by sea turtle populations or sea turtle species today are anthropogenic. While there are large numbers of various sources of mortality and various sources of problems that populations face, the so-called natural problems, natural threats, have been dealt with by the biology of the animals. The leatherback is the oldest of the species and it is about 120 million years old, that predates virtually every mammal on the planet. Therefore you can realize that these animals are finely tuned to the environments in which they live. Thus, the perturbations that have caused the declines have been primarily due to man's influence on these environments and on the species themselves. In my opinion, incidental take is the single most destructive threat faced by sea turtle populations in modern times.

128. There have been other threats, such as direct take which is a historically much longer term threat over the last maybe, 200 to 400 years, but in modern times, in the last 25 years, again this is my opinion but it is based on about 20 years of working with these creatures, incidental take is the most significant problem faced by all sea turtle species. There are other forms of challenges to the populations, such as habitat degradation is an issue in some countries and some areas, but when you read in our discussions that we feel that there are variations in the threats faced by sea turtles, you must realize that there are variations, there are quite a few different possible threats faced by sea turtle populations but the most significant ones are the incidental take of sea turtles by fishing industries.

129. The other point that I want to make is that of population status and stocks and we can have more discussion about this later. It is my opinion and my belief, again based on the years that I have been working with sea turtles, that at this time based on our current data available to us on the biology of sea turtles that we cannot consider individual stocks as individual management units and this is primarily because we do not know the full range of each of these stocks. Now there are some wonderful techniques coming on line that have allowed us to begin to solve some of those issues but it will be many many years until we can adequately say we know that this particular individual stock can be treated as independent management unit. I will go into more detail on that again as we bring the discussion back up. The other issue is conservation programmes. Conservation programmes must be specifically tailored to address the primary threat faced by the species and I do not think that there is any question among any of us on that particular issue. Which means that if bycatch is a primary reason for species to decline you must address bycatch. If nesting beach perturbations have been a problem, rather that the habitat degradation, the illegal or the legal harvest of eggs or of nesting females, those must be addressed specifically. I do not believe that it is possible to mitigate incidental take in fisheries if that is your problem by simply trying to enhance production on a nesting beach. The data that we have so far to date suggests that this is simply is not a valid mitigation measure. You must take a multifaceted approach to all of your conservation. Conservation must address the problems in order of priority and the problems in order of impact on the species itself. I think that that summarizes my comments for today, thank you.

Chairman

130. Thank you very much. Perhaps I could now invite Dr. Frazier to give his opening statement.

Dr. Frazier

131. Mr. Chairman, distinguished members of the Panel, distinguished delegates, I would like to reciprocate the thanks, I think that it is extremely important that science be used to the fullest of its capabilities in the resolution of disputes when it concerns resources which are important to peoples and the development of countries. I realize that this is not a simple process, it has not been simple for me and I do not think that it has been simple for my colleagues. I'm sure it has complicated the lives of many people, nonetheless, I am grateful that we have been given the chance.

132. I am a biologist, I am trained in biology, I am trained in ecology. Those who have looked at my submission will see that I have made an effort to venture out into another discipline, the discipline which is to some of us in biology, is part of biology, but usually is described as a social science. You have read more about sea turtles, you will hear more about sea turtles, during the course of today and tomorrow than you will ever want to hear, I am sure. And I will do my best not to belabour more sea turtle biology, I think that the experts on either side of me can do that perfectly well; I would like to draw attention to something which I feel has been left out of this discussion. Why is there trade? Trade is for people, and trade must be done for the best number of people in a society. I am deeply concerned that the social aspects involved in this have not been included. I see us from a perspective of someone who has worked and spent their life studying turtles and dealing with different problems of conservation of sea turtles, and more recently fisheries issues, and I see, I perceive in a way we are very close to an exercise which could be described as rearranging the deck chairs on the Titanic. The Titanic was a large ship which was sunk in the North Atlantic, and to rearrange the deck chairs on a ship which is about to sink is a useless venture. The trade issue, I desperately hope, can be put into a social context. What we have in conservation biology is what is called a flagship species, a sea turtle is a charismatic animal. What we see here today is because sea turtles are charismatic. If this was involving stone fish or indeed sharks, other species of marine resources which one could equally argue are in desperate need of conservation, issues which in fact may have great value to societies of the countries here, I doubt very much that this would have occurred. It is because sea turtles are charismatic
that political action can be focused on. It is with this philosophy that I have addressed the question, hoping that using sea turtles as charismatic species, as flagships, very deep problems, environmental problems, fisheries problems can be resolved. It is my feeling that trade must benefit the largest number of people in a country. I am deeply concerned by the little I have been able to learn in the short time available about the way the shrimp industry functions. I am not convinced that the shrimp industry functions to help the largest number of people in the producing societies. I realize that I am taking this discussion away from the focus of the main points but nonetheless, I feel that, unless the root problems of a dispute, of a conflict in environment, in society are resolved, we are dangerously close to rearranging deck chairs on the Titanic.

Chairman

133. Thank you very much. Perhaps I could now invite Dr. Guinea to make his opening statement.

Mr. Guinea

134. Thank you Mr. Chairman. Ladies and gentlemen thank you for the opportunity for me to highlight some of the aspects of my submission. I would like to thank the Chairman, Mr. Cartland and members of the Panel and would also like to take the opportunity to thank Ms. Cossy for organizing so well. I would also like to thank my colleagues for the stimulating presentations and the truthfulness of their discussions. I have been involved with sea turtle research since 1970 as a volunteer and over the last couple of decades as a lecturer at universities and so my presentation is based mainly on observations and discussions through scientific literature with colleagues, particularly in Australia. Shrimp trawling in the USA has been responsible for killing numerous sea turtles, there is no doubt about that and that is not a subject that we are arguing about. US legislation

requiring TEDs on all shrimp trawl nets is believed to have reduced this mortality, the USA restrictions on imported shrimp is based on reasoning if the demographic units of sea turtles that inhabit the Gulf of Mexico and the Caribbean Sea are depleted by present day trawling, then all sea turtles are threatened by shrimp trawling. The proposed solution to this problem is the forced implementation of TEDs for all shrimp trawl fleets in countries that export shrimp to the USA. During reading the material, I was looking for several aspects, several things in the submissions, the information I was looking for was the size of other fisheries and their respective effort in the impact on sea turtles, so this is other fisheries going on in conjunction with trawl fisheries. Statistics on sea turtle mortality by other fishing gear, for example gill nets existing shrimp management measures, protected areas for shrimp breeding grounds, nursery areas, protected areas rich in biodiversity, distance offshore and minimum depth limitations. I was also looking for gear limitations, size of vessels, types and numbers of nets and the economic trawl time durations for different shrimp species and these were not provided. Fishing activity, for example diurnal and nocturnal trawling restrictions and seasonal closures were also not provided.

135. Other points for consideration. I was looking at the embargo that had focused not on the product, but rather, how it was caught and the aspirations that all sea turtles would benefit once this threatening process is reduced. There is no indication or milestones or checks to ascertain if the embargo has had the desired effect in the affected countries. The questions that need to be considered. We are looking at sea turtle survival by measuring mortality and we should be looking for surrogate indicators of sea turtle mortality, things such as trawling effort and catch rates of turtles in trawl nets. Has the embargo reduced sea turtle mortality from trawling in those countries that did not comply with the TED requirements on all shrimp trawl nets? Did shrimp prices in the USA increase to entice countries to comply with TED requirements so as to gain access to a more lucrative market for their products? And were other markets found for shrimp that were banned from the USA market? Were shrimp or shrimp products transshipped through third party countries to the USA? And has the embargo had the desired effect? TEDs are just one option in the responsible management of a fishery. If the cause of the decline of a demographic unit is shrimp trawling, then the use of TEDs will assist in the recovery of the species. If, however, the breeding unit is threatened by excessive egg harvesting, then increase in hatchling survivorship should be the priority of management measures. If gill nets are the problem, then there are many options available to modify nets and their deployment to reduce the negative impacts on sea turtles. Data on sea turtle mortality and trawl fisheries are relatively easy to obtain, replicate and analyze. By their presence offshore trawlers are easily implicated in sea turtle strandings. Data on sea turtle mortality in gill nets are not so forthcoming and gill nets are not so readily implicated in the deaths of sea turtles. I am concerned that TEDs will be seen as the panacea to prevent sea turtle extinction. Other management options have to be employed as sea turtles are just one component of the by-catch. Restrictions on areas, seasons and fishing effort of trawls are needed to protect shrimp stocks, their habitats and other marine species which are less charismatic than marine turtles for example sea snakes. Thank you Mr. Chairman.

Chairman

136. Thank you very much. Perhaps I could now invite Dr. Liew to make his opening statement.

Mr. Liew

137. Thank you Mr. Chairman. Just to clarify, I am not Dr. but just Mr. Thanks again ladies and gentlemen. What I want to say here is there has been some confusion as to what constitutes a population in sea turtles. Some may define, for example, you are going to say the green turtle population in the world is facing problems, or the loggerhead population in the world is facing

problems, but can we solve the problem by treating this as a global population? I think the way to manage sea turtles is we have to identify each individual population unit or breeding unit. Breeding units of loggerheads in the United States is different from the breeding units of loggerheads in Australia and each breeding unit or population unit has got its own problems. It is difficult for us to say if shrimp trawling harms loggerheads in the States, the same process would harm loggerheads in Australia and the same process would harm loggerheads in Oman. The Oman loggerhead population is still the largest population, but can we give a blanket coverage? So the similar situation applies for all the other species of sea turtles. We have to identify breeding units, we have to identify what are the actual threats for each of these breeding units and then tackle from there and thus work up priorities and handle them one by one. So to give a global consensus or issue saying that shrimp trawlers is the most important problem, then it would take the focus away from other problems that may be affecting that particular breeding unit. So I think, that is a point I wish to make in this first statement. Thank you Mr. Chairman.

Chairman

138. Thank you very much. Finally, perhaps I can ask Dr. Poiner, if he would make his opening statement.

Dr. Poiner

139. Thanks Mr. Chairman. My background, I come from probably a little bit different than the other four experts in the sense that my background is in dealing with the impacts of fishing on ecosystems and in particular looking at the impacts of prawn trawling, as well as shrimp trawling, but being an Australian we tend to refer to them as prawns, on the system, including the impacts on turtle populations. Indeed, it is a significant issue worldwide. I think in my opening statement, I'd like to mention from a technical point of view, summarize what the assessment process, that we go through in making decisions about the status of some of these stocks, because I think that its quite important that people may be not as technically involved, understand some of the problems associated with that process. So to put it simply, firstly, we look at biological and ecological data on life history and habitats of a population. Secondly we look at estimates of natural and anthropogenic rates of mortality by age or size on the population and use all that information, usually in modelling studies using mathematical models, to come up with estimates of the status of the stock and then following up often estimates of the chances of recovery of that stock following different, using different management measures. I think, be it turtles or be it southern blue finn tuna or be it many different marine populations and probably terrestrial populations too. Often there is general agreement, and I think what we are following here, there is a general agreement about the status of the stocks and that for sea turtles you have the status that they are fairly low population levels. However, you usually find that differences in terms of looking at recovery or under different management regimes and I think that is what you will find, both in terms of the cases being put by the experts and by the parties, that really we are trying to predict the future, when we are dealing with a great deal of uncertainty about the information and it is how we deal with that uncertainty generally results in different outcomes or different predictions. The other thing that I think is important to know is that this is a interactive process. It is not a set process and all the time more information more data comes in, so the process is repeated and hopefully gets a little bit more certain. I think that some of the uncertainty that often arises, and I think has arisen in this process is uncertainty about the identification of a stock. We have already heard two experts, one placing a lot of emphasis on the identification of breeding unit, I would tend to concur with that, another saying that we need to take a more global perspective. I think that there is often inter-annual fluctuations in many of the things, many of the information and I think how you deal with those fluctuations often has an impact on your outcomes. There are always logistical and jurisdictional problems that always create other uncertainties and dealing with such long-lived animals as turtles that there is simply difficulties in detecting trends in populations. How

we deal with the uncertainty in our population estimates often leads to different predictions. I think that we need to be aware of it and I think what we will find and what we need to discuss today is not so much the status of the stock but looking at what is the likelihood of recovery using different management tools.

140. The other thing, just before I finish, I'd like to make a comment on because I, having been involved heavily in the introduction of TEDs and other bycatch reduction devices, certainly in Australian fisheries, I think there has been a little bit of, we need a little bit more elaboration on the introduction of some of those devises into a fishery. I think that it is important and I don't think that it is argued anywhere now that the properly selected and installed TEDs are very effective at reducing turtle catches and turtle mortalities. That's a fairly easily demonstrated thing, it's a fairly straightforward simple process of doing it, I can elaborate on that later. However, TED performance in a commercial fishery is a different issue and that's an issue of understanding the fishery and understanding the area where the fishery is being undertaken. And in understanding the fishery, that's both biophysical issues but also socio-economic issues and the introduction of TEDs via these indoor fisheries is not a simple process. It is a process that will often take, well from the Australian experience, it's is probably going to take us about six to eight years to do. And I think that's an important point and the other issue is that, be it TEDs or be it area closures or be it seasonal closures or be it a whole variety of management techniques, monitoring enforcement will always be an issue in the fishery. And I think I'll leave my opening comments at that point. Thanks Mr. Chairman.

Chairman

141. Thank you very much. I think those initial statements already point the way to further discussion on some issues and I think that perhaps, as we go into the second round, I think Dr. Eckert mentioned population status and stocks as something that he would like to come back to, and I think that we have already seen that there is some discussion there against the global approach as opposed to the breeding unit approach. I think perhaps you might want to take the opportunity of the second round to take us a little further into that subject. Dr. Eckert you have the floor.

Dr. Eckert

142. Thank you for the opportunity to visit the issue of stocks. Let me begin by saying that I am actually in complete agreement with my colleagues relative to the need to define what individual stock boundaries are. And that progress is being made in that particular direction. The advent of DNA fingerprinting or mtDNA, as it's referred to mitochondrial DNA, the linking of females to their native beaches is an excellent means by which we can begin to understand stocks. The increasing use of satellite telemetry to actually monitor the movement patterns of females away from their home stock is also excellent. All of these lead us down the path to being able to define stocks in terms of how we have traditionally measured them and that is based on the number of females annually nesting in a nesting beach. We are also improving our ability to estimate what percentage of the at least female population is represented by those nesting females on the beach. Where I have some concerns, is that an issue that has been defined and fairly well agreed upon, I think, by all the scientific panel, is that we need to address specific issues that are threatening the sea turtle populations. However, our ability to define the stock boundaries is still too immature to be able to do that. Now, what that means for us is the following. If we have a sea turtle population nesting in country X, I try not to use a specific country because this is just a model, but if we have a sea turtle population nesting in country X, and we have that population distributing to, say, 15 other countries of various regional distances from that nesting beach, we are then faced with saying OK, countries 1 through 10 have shrimp trawling and they have a high incidental take, countries 10 through 11 through 15 have gill net fleets and they're taking turtles in that fleet. Now, how do we, from a

management perspective, apportion if we are not aware of the gill netting problem as a possible source of mortality, so for example if we only know where 10 of the 15 resident populations live, and we are seeing a population decline on our beach, who do we blame? And, what I'd have to say about that is right now, we simply do not have enough data to be able to tell you where the stocks in the world today go when they leave their nesting beaches. The other issue is that of juvenile foraging habitats in juveniles. The amount of information that we have on where juveniles reside, and juveniles will move through various habitats and various areas, they are not fixed on one particular regional jurisdiction, we know less about, much less about than we know about even with females. And in my own research, what I begun to realize is the more we look, the more range the stocks inhabit and the more overlaps there are between stocks, so your particular beach that you are monitoring the population on, on the foraging grounds it may overlap with 10 other populations.

143. So we have got to be very very aware of these issues if we are going to address the problem in a manner that is most applicable to the populations. Let me just briefly show you some examples of what I mean by this discussion. I am going to switch over to this microphone. Can everybody hear that needs to hear? Those two issues that we need to be aware of when we are talking about stocks, the one issue is what of the stock ranges. Where are these animals actually going after they leave their nesting beaches? Or where were these juveniles residing and how were they moving around between those areas? What I've argued is that we really don't know from most populations what is the full extent of their range or where these populations will move. What I've also argued is that we're getting there and in maybe another 10 years, we will be able to define those issues for you very well. There is a tremendous amount of very good work going on in Australia right now with this and the United States is also beginning to do quite a bit of work in gathering DNA tissue samples from turtles to be able to piece them back to their natal beaches, at least for nesting females.

144. But we have a very long way to go before we are going to be able to do that adequately. Now, as an example, there are some populations in which we understand a little bit more about the juveniles. One of the loggerhead populations in the Atlantic and the Pacific, and what we have found from those is that they make trans-Pacific or trans-Atlantic migrations and they will reside in developmental habitats on the other side of the ocean where they will remain for a number of years. In the case of the Atlantic, loggerheads breeding on the Carolina Coast, the Georgia Coast, the Florida Coast, all will move over towards the Azores on the other side of the Atlantic where they will grow up for a while and then they will swim back. In the Pacific we see the same thing. Stocks that are hatched in Japan are actually developing and growing off the coast of Baja and off the coast of California in that they will then migrate back to Japan. So you see right there we have a very very long distance between where these populations are actually residing and yet they would be identified as Japanese loggerheads, if we take a strict stock basis. That's the only species we can say that about. We cannot say that about any other species with certainty.

145. The other issue then becomes one of, OK, given that we don't know where these things go, how are we going to assign jurisdiction to them from a regional perspective? Now, a lot of my research over the years has focused on satellite telemetry as a methodology for understanding the movements and the habitats of the animals. I work predominantly with leatherback sea turtles and so let me bring up a few things about leatherbacks that we have determined over the last few years.

146. [See graphs 1 and 2, Appendix 1] With leatherbacks, the paradigm for understanding leatherbacks used to be that they move north and south, they nest in the tropics, they nest and then they move into the North Pacific or the North Atlantic waters where they will feed and then they will migrate back. That was based on tag returns. Tag returns data we have is the point they were tagged on this particular beach, they were recovered usually as a dead animal at some other point. It was considered pretty much a migration, point A to point B. However, when satellite telemetry came on line, and I began to use satellite telemetry to understand the movement patterns of leatherheads in particular, what we have found is that leatherbounds are not just making north-south migrations but

they are likely making circum-oceanic migrations, they are making regular forays around the perimeter of the oceans. These two data sets, this upper one here was leatherbacks that were tracked out of the country of Trinidad in the Southern Caribbean off the coast of Venezuela here. I tracked three turtles, one of the transmitters was entangled in a gill net and damaged and so it failed early, the other two transmitters gave us the first perspective that leatherbacks may be doing something other than just simply making north-south migrations which is what we had from tag data. Then this animal moved up into the north Atlantic, it spent about a month and a half here and then it migrated down to the coast of Africa. This animal moved across the Atlantic up into the Bay of Biscay, then it too moved down the coast of Africa. Now, some significant issues are these two animals left within a week of each other in their northern habitats to get down to the southern habitats. Not only did these animals know where they were, they also knew what time of year it was, and where they had to get to. In Mexico this is a project which is ongoing right now, I am currently tracking leatherbacks off the Pacific Coast of Mexico. The animals have moved south here to the coast of Chile. The "El Niño" has caused some problems down here when they got into some warm water, and you can see that some of them have made divergences out away from there. What does this tell us about movements and how can I say that it is not that they are simply making north-south movements based on this.

147. Well, my hypothesis is this. Here, off the African coast at the time of year when the turtles appear, there is a tremendous amount of upwelling, that means coastal production has risen quite a bit and there is a lot of food for leatherbacks to eat. Same thing goes in these two northern habitats at the time of year they are here. Basically, what this species appears to be doing is following sources of food. They know that food is going to be prevalent down here in the early parts of the year so they migrate down to there and they are driven by that particular pattern. Here in Mexico, these animals have spent three to six months reproducing, probably feeding very little, they head for the first closest they can find where there is going to be food available. For the leatherbacks that means jellyfish. That's here at the coast of Chile and Peru. These are areas very famous for their fisheries. Where do they go from here? The hypothesis that I have proposed is that leatherbacks make this kind of migratory patterns in both the Pacific and ... [tape turnover] ... split the Pacific down the middle like this particular mapping programme doesn't allow me ship the Pacific over to centre its focus. These are the animals that we tracked south. I'm hypothesizing that they move out across the Pacific after they feed here and they come up into this northern Pacific area here and then make their way back around in a circular pattern in the Pacific. That's very much the pattern we have already documented for the Atlantic. The reason I 'm proposing that they go from here up to here is that we know in this area that the drift net fleets were catching large numbers of leatherbacks in the mid 1980s. These leatherbacks' subsequent data, genetic data, has indicated that incidentally caught leatherbacks from the Hawaiian long lined fleets here, exhibit the signature familiar with those that we would see from Mexico and Costa Rica. So therefore, these animals simply have to be getting up here somehow and this appears to be the route that they are taking.

148. Now, in the case of Malaysia and the large nesting colony down here in Irian Jaya, in Indonesia, there's also DNA evidence and a single tag return from Malaysia to "Hawaii", we haven't exactly been able to sort out what that means, but that clearly indicates that that animal moved into the north Pacific. There is DNA evidence indicating that Irian Jaya turtles from here have stranded on the California coast as well as been encountered up in this area. So I think that the hypothesis that these animals are making multi-jurisdictional migratory movements around the perimeter of the ocean to take opportunities for good feeding is very very real. Now, my point of belabouring this whole issue to you is that the only reason we knew or we are beginning to discover that these turtles were making these kind of movements is with the advent of the most recent technologies and satellite telemetry and DNA. The number of sea turtles of all species that have ever been tracked by satellite, probably numbers less than 50, with many data anything other than just a few weeks of information. Yet, we are trying to say that we can define the stocks of sea turtles based on these very few studies

so that we can then address the particular threats that are perturbing these individual stocks and I am arguing that we simply do not have the data to allow for that yet. Now, there is a practicality issue and that practicality issue is: is it practical to say well, since we can't identify stocks, therefore we need to address the threats on a global level and what I argue is yes, that is exactly the situation. We know that it has been well demonstrated that turtle populations were severely damaged by shrimp trawling in at least one country of the world. That's why I think it is prudent to make the same argument that if shrimp trawling is as destructive to sea turtle populations in that country, then it is likely destructive to sea turtle populations elsewhere in the world and this is where I'm probably going to have some disagreement with my colleagues. But the bottom line is the way a shrimp trawler fleet operates perturbs the environment and if there are turtles present, and that is a significant question, if there are turtles present, I would argue that they will be drowned by shrimp fleets or shrimp fleet activities.

149. There has also been some discussion, at least in the comments I received the other day, relative to jurisdictional aspects and this falls very much within the same parameters as understanding stocks. You have to understand jurisdiction, and as I understand it, if you don't have jurisdiction, you don't have the ability to introduce this sort of regulations. I want to show you this briefly [see graph 3, Appendix 1]. Remember there is very little data on green turtle movements from Malaysia or Thailand in the case of the Pacific which is the area that I am most familiar with. There have been some satellite tracking studies and there is some DNA evidence being gathered. There is no data to indicate that green turtles have ever been recovered from Guam or the Northern Mariana Islands that I'm aware of. Maybe my colleagues would know something else. However, the fact that there is no evidence for that doesn't mean that it doesn't exist and I know that's a really strange and backwards way of approaching it, but that's simply the issue. There has not been enough research done to indicate rather there is jurisdictional overlap with these populations. I argue that there is jurisdictional overlap with leatherbacks and I think I have demonstrated that and it is being demonstrated by DNA evidence as well and there is possibly jurisdictional overlap with green turtle populations here. Twenty seven hundred kilometres is well within the range of post-nesting migrations of female green turtles for the western Pacific. So those are the issues that I wanted to point out briefly and I am sure that that'll stimulate a little bit more discussion and maybe we'll come to some consensus as to where, as a scientific community, we all fall in on this particular issue.

Chairman

150. Thank you very much Dr. Eckert. In continuing the round, I don't know whether Dr. Frazier wishes to jump in on this question of the population stocks which we have now got into or whether you would like to come back a little bit later on to talk perhaps about the Titanic and the deckchairs at a later stage. Otherwise, I could go to one of the other experts who also flag this subject and hear perhaps a slightly different perspective on the issue we have just been discussing.

Dr. Frazier

151. I think what I am hearing is people speaking to the same issue, but using different ways to get to it. A concern which Dr. Eckert mentions about no information is not negative information, is fundamental to science and this same concern is well expressed in the FAO Code of Conduct for Responsible Fisheries. If you don't know something, there is not a reason not to protect it. I think that is a very simple issue. To fine tune, to describe in more detail what a breeding stock is, and where it lives, and what countries have rights to it will take us many years, and I think all parties here would agree that when they're on the high seas, then they are common resources to the world community, not in anyone's jurisdiction, but in fact in everyone's jurisdiction. I think the complication here is at different levels, it is political and it's biological.

Chairman

152. Thank you. Dr. Guinea you certainly mentioned the breeding units and perhaps you would like to go on with that.

Mr. Guinea

153. Yes, thank you Mr. Chairman. The fundamental unit of conservation is the breeding unit from my perspective. We measure the populations of sea turtles by the number of nesting females. Very few studies have produced estimates of population size from other than nesting females. A few feeding ground studies in limited areas will usually present densities or a biomass per hectare or square kilometre, but the unit of population size is traditionally the number of females that nest in a particular year or because of some species having high fluctuations from year to year in their nesting populations maybe over a number of years, a decade or even longer to get an indication of the yearly fluctuations in population size and also population fluctuations associated with cyclical events such as the "El Niño" or the southern oscillation event.

154. So the breeding unit is what we measure. We measure the number of females on a particular breeding beach, or in a particular locality, whether it's one island or several islands and that becomes the unit. I should say that a lot of work has been done with tagging sea turtles. There are large numbers of sea turtles carrying tags around the oceans of the world. Dr. Eckert has indicated new technologies that have come onto line. These include mitochondrial DNA studies whereby the maternal lineage is determined for a nesting population, which indicates that because the mitochondria are not carried in the sperm and are not transferred to the ovum, therefore each individual carries the mitochondria from its mother and therefore, because of the characteristics of that mitochondria, the DNA finger print can be established for a breeding unit. It might be one island. It might be several islands. Sea turtles will move either on a yearly basis, in some areas. In some areas, they may even move on a nightly basis between islands, if one island isn't particularly satisfactory. So, the tagging studies are some of the most basic studies of sea turtles. Mitochondrial DNA studies support tagging studies. If mitochondrial DNA studies were in conflict with tagging studies, then they would not have progressed, regardless of the theory associated with them. Latest technology, looking at satellite telemetry. Again, if satellite telemetry did not agree with tagging studies and mitochondrial studies, it wouldn't be accepted and this, as Dr. Eckert has indicated, is a new technology. There are probably fewer than 50 sea turtles carrying satellite tags as he mentioned. There are also other means of looking at the migratory routes of sea turtles. A thing such as temperature depth datalogue is attached to sea turtles, whereby the depth to which they dive, the temperature of the waters through which they move. This information can be carried with the turtle and when it returns to its feeding ground or nesting beach, then a map can be produced of where the turtle actually went or at least the limitations of where the turtle has been during its nesting migrations.

155. In Australia, the breeding units of turtles that are involved with shrimp trawls. I should also point out that the leatherback sea turtle is not a species that is negatively impacted by shrimp trawling, but the loggerhead populations in Australia are nominated as being affected by shrimp trawling as are the Australian flatback sea turtles. These turtles do move from feeding grounds to breeding grounds and back to feeding grounds on a regular basis. With work in Queensland, where turtles are being satellite tagged as well as using depth-temperature dataloggers as well as using mitochondrial DNA as well as using physical tags, turtles can be monitored throughout the year. The laparoscopic investigation, this is internal investigation, can determine when they are about to breed and almost the day when the turtle leaves its feeding ground can be nominated. It can be tracked to its nesting ground. Researchers find her on the nesting beach. The number of nesting events can be recorded

and then the turtle can be tracked back to its feeding ground again. So, with some populations, you can define where most of the population is residing. Admittedly there are some populations, some loggerheads, that will move to New Caledonia from Queensland, for either feeding or breeding. Loggerhead turtles that feed on the southern Great Barrier Reef are known to migrate to New Caledonia to breed and then return at the end of the breeding season to exactly the same reef on the southern Great Barrier Reef. Similarly, sea turtles found feeding in New Caledonia move into Queensland for nesting.

156. So, the concept of breeding units can be established. I think we have a number of countries in very close proximity to each other. If you are looking at the turtles or the species that are involved with shrimp trawling. And we could nominate those as being loggerheads, the Australian flatback is not one of those listed in the dispute, the olive ridley sea turtle, also the hawksbill turtle and the green turtle to some extent. Their movements are fairly well known for some countries. Just because we don't know the movement of every turtle from a population in every country, there is no reason to say that we should disregard the idea of breeding units. The breeding unit is the only tool we have to say whether our numbers are increasing or decreasing and because of that I would stress again the need to use the paradigm of a breeding unit as a conservation unit and this is very important for those species that are affected by shrimp trawling.

Mr. Liew

157. Thank you again. [referring to graph 4, Appendix 2] There are two things when you talk about movements of turtles. One is the hatchling - that means those that have just emerged from the nest - so they also will move in the oceans and hatchlings are oceanic. That means that once they have emerged from the nest they will run straight into the sea and they will swim offshore and the prevailing currents will then carry them. And some of them, we don't know how many, will be carried into the ocean and they will circulate the ocean. So, for example if they are hatchlings that come from Terengganu in Malaysia, currents will then carry them and if the currents are flushing up and down [indicating the South China Sea] then they will follow the currents and be flushed up and down. Some of the hatchlings will make their way to the open oceans and promptly they will be carried into the open ocean. But you must remember, the hatchlings are very small, they are pelagic, they will remain very near the surface and they will be moving around and probably going a few times [around the Pacific Ocean gyres], we don't know. And for 5 [to] 7 years or even more until they grow up to a size of about a dinner plate. So during this period, they are more or less dispersed, this is the dispersion phase which most scientists agree to, but you must remember that during this phase they are really pelagic, shrimp trawlers are of no threat to them.

158. So even though you find juveniles coming here [pointing at the Californian/Mexican coast, graph 5, Appendix 2] they are still pelagic, there is very little chance that they get caught in shrimp trawlers. But they may be caught in gill nets, drift nets and so on. So, if you are talking about the loggerheads that nest here [pointing at Japan], the juveniles occur here [pointing at the Californian/Mexican coast] but eventually, when they decide to settle into their feeding grounds, they probably will try to make their way back to somewhere nearer this location [pointing at the coast off China]. So that is the pelagic phase. So, once they have completed the pelagic phase, they would then try to settle, especially for the loggerheads, the greens, the hawksbills and olive ridleys, they would settle and have already benthic habitat, that means they remain feeding close to the sea floor. That is the time when shrimp trawlers will impact them. But usually, by that time they would be settling closer to where the nesting grounds are. You are talking about a distance of nearly 10,000 km [referring to the distance across the Pacific Ocean], so that is why in general you find feeding grounds and nesting grounds to be in a close region, not feeding grounds here [pointing at the Californian/Mexican coast] and then nesting grounds there [pointing at Japan]. So, like the breeding unit in Hawaii, you will find that they will probably be feeding in the region along that area

[indicating the region around Hawaii]. The breeding unit of loggerheads in Japan will be feeding around there. The adults will be feeding around there and, in fact, satellite telemetry studies by the Fisheries Department in Japan have found that their loggerheads move to the coast of China to feed and there is where the feeding grounds are, not here [pointing at the Californian/Mexican coast].

159. Similarly for Australia, feeding grounds are around there [indicating the northeastern Australian region] and for this part and there [indicating the northwestern Australian region] for that region. It is very unlikely for turtles nesting here [pointing at the eastern Australian coast] to be feeding there [pointing at the northwestern Australian region]. To add to this point, I think that Mr. Guinea has already mentioned that Colin Limpus, in Australia, has made studies using laparoscopy to look at the abdominal cavity of female adults in their feeding grounds. And by looking, using the tube and a light they could see what is inside the abdominal cavity. And they found green turtles when they are feeding, the abdominal cavity is filled with food because they feed on sea grass and all that. And when they found that the females are about to breed, that means, about to make their migration to the nesting ground, the big follicles would have already formed and they would take quite a large amount of area in the abdominal cavity and there is very little food left in the gut. So, which means for a female to make their migration to the nesting ground, they will have to accumulate a lot of energy stores in their fat. So that is why you find turtles spending 3, 4 or 5 years before they will make their migration to breed, because they need to gather up enough or sufficient energy stores to make the migration.

160. So, in our work in Terrenganu, we have been tagging turtles for quite a number of years and every turtle that comes to the beach, we tag them, so we will know when the turtle first nests until the last day that she nests. So we will know exactly when was the first day she nested until the very last day. And some of them have nested 10 times. And every time there is a nesting interval of about 10 days, so you are talking about 100 days interval at the nesting ground. We have also satellite-tracked these turtles, the very same turtles, back to their feeding grounds. They would swim straight across the open ocean, they don't stop to feed and they would swim something like almost a month continuously before they reside back at their feeding ground. So you are talking about a turtle when they are ready to breed they will have to swim from their feeding ground, taking them one month, to their nesting ground. At the nesting ground they don't feed because the abdominal cavity is all full with eggs. There is no way they can feed and we have observed turtles, we have put ultra-sonic tags, we follow them, see what they do, we dive and observe what they are doing and most of the time the green turtles will be just sitting at the bottom and then waiting for the next nesting. They don't feed. So you are talking about 1 month to travel there and spending at least 2 months at the nesting site and then another month to go back to their feeding ground. So something like about 4 months without feeding. So, if you are talking about a loggerhead that is feeding here [pointing at the Californian/Mexican coast] and travelling 10,000 km to nest there [pointing at Japan] and then having to travel another 10,000 km to go back, it is very unlikely. So whatever loggerheads that are found here [pointingat the Californian Mexican coast] are probably just the pelagic phase and they will try to move back to areas very close to the nesting ground, because if you are talking about swimming 10,000 km, the swim itself will take at least 5 to 6 months without feeding and loggerheads, we are talking about loggerheads in the open Pacific Ocean, it is not very likely.

161. Sometimes you may find strays that may not make it back to the west [referring to the Western Pacific]. Those strays will probably not be able to nest because it is just too distant. So, that is why I would say, if you are talking about breeding units, they will be quite isolated. There is a certain range. You cannot talk about breeding unit as here to there [pointing from the Californian coast to Western Pacific]. You're not talking about that kind of range - you are talking about this kind of a range [indicating the regional areas as marked], beyond that I think it would be very hard for them to survive. Now, coming back to Scott Eckert's leatherbacks, where he tracked them going

south and he hypothesized that they would go across to here [pointing at the West Pacific] and come here [pointing at the Northern East Pacific]. Well, there is also another hypothesis. They could go from here directly to there. The numbers they could track is how many? 5, 10? Out of a total population of [Dr. Eckert's answer not audible]. OK, right, so I mean, I was thinking some of them may go south, some of them may go north, I don't know. But, going round the Pacific Ocean is just a hypothesis and yet to be proven. Perhaps it may be so, if he considers that all of them go south. But then we have also to remember the leatherbacks that are going in this Ocean are in very deep waters, totally not affected by shrimp trawling. Only high seas drift nets or gill nets or long lines will catch them. Trawling in Malaysia will not catch their turtles.

Chairman

162. Thank you. That brings us back to Dr. Poiner.

Dr. Poiner

163. Thanks Mr. Chairman. I'd like to raise two issues. I too think it is critically important that you focus on a breeding unit when deliberating and deciding on management measures. I also think it is very important that we are careful in not assuming that the process operating for one species of turtle will be the same process as operating for all species of turtle and I think the contrast from the information available for leatherbacks versus, say green turtles in and around the West Pacific is a good example to show that there are differences and I think there should be a great deal of care. Similarly, I think there should be a great deal of care in interpreting the impacts of fishing on different species in different areas. So, for example, Dr. Eckert mentioned that there is clear evidence that the US shrimp fisheries have had an impact on several species and I agree that there is clear evidence. But I also think, in determining the impact of a fishery on a breeding unit or globally, whatever perspective you take, you need to remember really that in making that assessment, the first thing you do is measure the catch rate of the turtles, in this case of the turtle species, and catch rates are usually relatively low in the sense that the number of turtles captured per number of trawls. Then you need to multiply that figure by the total effort, how much trawling in the overall fishery, to get a total number of individuals that are caught and then you need to make an assessment of what is the impact of that total number at whatever size on the population.

164. Now, fisheries vary tremendously and I think that the shrimp fisheries vary tremendously around the world in terms of the nature, distribution and level of effort. So, for example, where the incidental capture rate has been measured, and that has been in the southern US fisheries and the Australian fisheries, there is very little difference in terms of the catch rate, i.e. the number of times a shrimp trawl actually captures, say, a loggerhead turtle. However there is a significant difference in terms of the effort in the two fisheries. So, for example in the east coast Australian fishery and the Northern Australian fishery, the effort levels are much lower than in the Gulf of Mexico fisheries. Hence, the total number captured will be much less. So then you need to make an assessment of what is the level of impact. Now, I must make it clear I'm not arguing that in saying those Australian fisheries that shrimp trawling is not a significant source of mortality, but you would need to be very careful in arguing that just because you demonstrate, in this case, that the impact of fishing in the Southern Gulf, in the Gulf of Mexico in the other US fisheries has had an impact on species is the major source of mortality anthropogenic on species of turtles there. You have got to be very careful in making that assumption that therefore it will be the major source of mortality in other areas. So, for example, especially as we know in those other areas, there has been and continues to be significant source of mortality, be it direct harvest or be it egg harvests.

Chairman

165. Some new points have come out. Do the experts want to carry on and take those up? Or, Dr. Eckert, you are looking thoughtful.

Dr. Eckert

166. Yes, I guess I'm in a position to decide if we want to argue specific points or if I should try to back up a little bit, and think in terms of the overall thesis. I guess maybe what I can do is illustrate this issue a little bit with an example. One of Liew's comments relative to the loggerhead (Caretta caretta) and its distribution around the ocean basins is interesting. Off the coast of Mexico, where these animals are in their developmental habitat, Mexican shrimpers are indeed catching juvenile loggerheads and what I am trying to point out with continually revisiting this point that we need to be aware of the entire stock range of these species when we are trying to apply conservation, is that in situations like that, where the developmental habitats may occur in other countries' jurisdictions, you may see it in a distant country's nesting population. A case in point for that is on the US Atlantic coast, we have two distinct genetic loggerhead populations, those that nest in the Carolina and Georgia and those that nest in Florida. The Florida population appears relatively stable whereas the Carolina population and the Georgia population have declined very significantly. It appears that one of the reasons for that is that the juveniles of those populations forage in two different locations. The juveniles from the Carolina and Georgia forage in Carolina and Georgia and a little bit down in to Florida in shipping areas, whereas those that are coming from the Florida population are foraging out of the Bahamas where there is no shipping. And this has defined why there has been two very different reflections on the nesting beaches. So, my point, that I want to stress over again, is that we need to understand those particular stock issues before going to try to manage stocks on regional basis. One of the arguments that was put forth in some documentation that we received is that the Malaysian green turtle populations nesting in the Turtle Islands are recovering and therefore shrimping is not having an impact on those populations. Well, we have now heard quite a bit of documentation that green turtles do not forage where they necessarily feed and what probably hasn't been pointed out is that often, it isn't the nesting females that are impacted by fisheries, but rather the juveniles and the foraging females. Part of that comes from the way that these animals behave. As Liew pointed out, reproductive females, with the exception of the leatherback, do not feed during the nesting season and they tend to just hang out on the bottom often that will be in hard bottom areas where they are more secure. There has been some work done on diving behaviour in hawksbills and tracking work with hawksbills and green turtles that seemed to indicate that. And so, in the case of that particular argument - the fact that the population may be going up, indicates that it is not being impacted by shrimp fishing in the Turtle Islands - doesn't stand up. What you need to be looking at in that case is what are the juvenile populations and the resident female populations and resident mature populations, what is happening to them on their natal grounds. Again we have to get back to understanding what these stocks are, where these stocks go and before we are going to properly be able to talk in terms of stock management and that is simply my point.

Chairman

167. Dr. Frazier, do you have any further comments at this stage?

Dr. Frazier

168. I guess, briefly I basically am in agreement with both sides of the argument. I think that we are trying to fine tune a complex issue. I think we are all in agreement that we need to manage a stock, the question is what is that stock? and where does that stock reside. In the case of Australia, there are many years of studies; in the case of the US there are many years of studies and there is a reasonably good idea of where stocks go. In most cases, we don't have that information. That takes

us to this problem of no information is not negative information. The description that Liew gave distinguishing what leatherbacks do and what the hard-shelled turtles do, I find correct. The problem is: where can we actually say we know a stock well enough to be able to say all of the different means of protecting that stock throughout decades of maturity, of the animal developing to maturity, and then decades of living after that to its full reproductive potential? In most cases I don't believe we have that information. I agree that we must prioritize conservation activities, I am not convinced that we should have an either/or approach and look for the major, the most important and only do that. Sea turtle conservation strategies for decades have tried to impress upon the need for integrated activities, I think all the people here have argued that you need to protect eggs and you need to protect turtles in the oceans. Doing one and not the other is not enough. I am a bit confused as to why sometimes, some of the submissions seem to focus on the most important, I don't think that's the argument. I think the argument is integrating conservation, so that it takes into account all the distinct aspects of this very complicated animal. And in that respect we then come into what are the pragmatic ways to address some of those threats. And that then becomes a more political issue, that's outside the hands of biologists. In conservation biology, what we look for often are ways for users to pay for the way they are exploiting resources. There is a concept there of user pays.

169. Now on trade issues, this is not my training, but in trade issues I would say that that means incorporating the externalities into the cost of the product. So that the consumer then pays for the product. So that the product is both environmentally and socially acceptable to the producer. That's simply my way of seeing things, I don't see contention here, I see that we are viewing, I think Buddha made a statement once that three blind men describing an elephant would describe it in different terms. One a column, one a large wall and the other a fan and I certainly don't consider myself an expert, I am specialist, but I have great deal to learn about turtles although I spent 30 years learning about them. So I think we are probing here, there is something extremely complex that we are trying to grapple with, which is a great challenge to conserve.

Chairman

170. Thank you very much. Dr. Guinea, I think just to take that on a little bit. Dr. Poiner mentioned earlier that he thought we should be talking about the likelihood of recovery using different management tools. I am not sure whether those who were advocating the integrated approach mean we should use management tools all the time, or whether we should sort of try and prioritize it or identify different tools for different populations. I wonder if perhaps you could develop it a little further because I think in your original written proposals you talked about the importance of having nationally developed conservation programmes with a national flavour and I think that perhaps in that context it would be useful to hear whether you could develop the points a little bit more.

Mr. Guinea

171. Yes, in my original submission I was talking about countries developing ownerships of technologies and using technology appropriate to that country. This is part of the concept of responsible fishing. The individual countries have an idea of the resources they are taking from the sea, they know what is marketable, they know where the profit lies, whether the profit is in shrimp, whether the profit is in small fish, so in fact whether the bycatchers are one of the components of the profitability of the fishery. In that regard, the countries know what the target species are. By importing technologies, something that works in the USA or Australia or works in the other country that may be imposing a technology, the ownership of that technology stays with the exporting country until the receiving country has modified it to the fishery - modified it to their existing social, cultural and financial arrangements. This modification process gives the country an ownership and this also builds up a concept of, rather than importing something that is good for conservation of the species that is in our waters, this is now something that we are doing, we have modified a technology for our

present conditions. This may involve a modification to the design, a change in the net. I was very impressed when I saw the Thai Turtle-Free Device. It didn't resemble the Georgia Jumpers or the USA TEDs on which probably it had its origins and it was something that was definitely Thai looking. It had an elegance that you could associate with Thai and the Thai people. The technologists that demonstrated it showed it with a national pride. This was our TED. We have a similar situation in Australia where we have the AusTED and our AusTED doesn't resemble a number of TEDs that you can commercially buy from America, but our AusTED is flexible. So it is not a rigid TED, it is not a soft TED, it is a flexible TED made of plastic coated stainless steel cables. It has cross members which are different to other TED designs. and trials in Australian waters have indicated that the fishing fleet are happy with it. Although more refinement, more experimentation is required, there is a general feeling that, yes, this is something that we have developed, that has come from CSIRO, has come from various fishing organizations. ... [end of tape]

Dr. Poiner

172. ... the issue I was raising is in terms of the way you will introduce a bycatch reduction device, call it TED or whatever, and how you use that tool in fishery. You can do it in different ways. One way is to do a certification approach, that has been used and then you focus a lot on certifying reperformance of that device. The other you take, is an agreement on specific targets and then let the industry or whoever develop ways of meeting those targets and then you focus on monitoring of performance and reaching that target rather than certification. In different fisheries and different conditions we will use those different approaches.

Chairman

173. Thank you very much. Dr. Frazier would you like to continue on that one?

Dr. Frazier

174. I think the lessons to be learned from the Australian fisheries are profound. The Australian fisheries are what are called "closed entry". There is a limited number of vessels which can go and shrimp. Unfortunately that model of managing fisheries is not common. If other countries could have done what Australia has done, we would all be much better off today. The people responsible for developing TEDs in the US had originally planned on voluntary compliance, and there was a long period of trying to make that work. The fishery is over-capitalized, there are too many people fishing, as in many countries, as in most countries, and in the end the only way to make it work, was through certification - was to go the other road. That was not the original intention, in terms of what I understand, although perhaps Dr. Eckert who has worked in that area more than I have, could clarify - my understanding was the original intention was voluntary compliance. But because it is an open-entry fishery, it means it is a free-for-all. And therefore, it is not only a national sense of ownership, it is more of a personal sense of responsibility toward the fishery. This is what we lack on a world basis now. With a few exceptions, and Australia is one of those exceptions.

Chairman

175. There are others, are there?

Dr. Eckert

176. New Zealand.

Dr. Frazier

177. Well, the ITQs [individual transferable quotas] are not working there, I don't think.

Dr. Poiner

178. One comment: limited entry does not necessarily equate to reduced effort, I think that should be the point. It just means limited entry is used often to either manage over-capitalization rather than effort-reductions. So for example, one example I am very familiar with in the Australian Northern Prawn Fishery where a halving in the number of participants does not mean a halving of the effort. And the effort for a variety of reasons is now approaching the same levels with half that number of participants. So you should be very careful in that. Because you get into issues of efficiency of the fleet. The argument I was raising here was that I think the important issue when dealing with the management of fisheries, be it the management of the stock being targeted or the management of the impact of those fisheries, you need to be very careful and you need to be very clear in terms of the nature of the fishery and what the management objectives of that fishery are.

Chairman

179. On the same point, Dr. Eckert.

Dr. Eckert

180. Just a brief comment. My understanding, and I can be corrected by my Australian colleagues, but the Australian fishery is sociologically quite different from what we saw in the United States. In the United States shrimp fishermen are generally independent owner-operators. I was in the south-east during a lot of this bru-ha-ha, so I understand a lot of what went on in the application of TEDs, and one of the great problems that occurred there was that these independent operators-owners do not have an umbrella spokesperson or any kind of an organization under which they work cooperatively. So when approaches were made to them to voluntarily adopt things, you basically had to go to each boat, to each owner, to each little parish in Louisiana, and say "will you please use TEDs and here's why." From an environmental education perspective, which is often a good way of introducing these sorts of issues, because it has been my experience that shrimp fishermen care more about the environment that they are working in, than just about any people I know. They are very sensitive to what is going on out there. But you need to introduce the issue of turtles to them. The reason it was such a dismal failure in the United States was simply that it was too big a task. In Australia, it is a relatively young fishery, it appears that they have tremendous cooperation, government to industry and industry as an industry, instead of a bunch of individual guys out there fishing. So, when you talk about the approaches that transpired into actually introducing TEDs or BRDs (bycatch reduction devices) into the fleet, it has been a much more pleasant task, and this is why Australia can talk in terms of voluntary, probably getting good cooperation on voluntary introduction, whereas in the United States, despite very valiant attempts, it was an absolute failure. It is also one of the reasons why the application of TED regulations in the United States was so slow in coming. There has often been discussion that application of TEDs took 10 or 15 years in the United States. Well, this is often why. They went down a lot of blind-ends before they finally found the scenario that worked. And I would have to say that that has only been at most 5 years, it really hasn't been that long before an effective way of getting TEDs put into place has occurred.

Chairman

181. Thank you. I am sorry Dr. Liew, I have kept you waiting a long time. You have got some new subjects to raise.

Mr. Liew

182. Before that, I just want to ask a question. Should not the voluntary option be given first, before you force somebody? Should not the fishermen or the country be given the voluntary option?

183. I would just raise some points that I have noticed in some of the other experts' deliberations. This is about protecting eggs or adults and about using reproductive values to say that it is more important to protect adults than to protect the eggs. A healthy population needs individuals in all stages of development, not just eggs or just the adults. It would be detrimental to turtle populations to say that we should protect the adults and allow rampant egg harvest to continue in countries, especially when commercial egg harvest is still a very major threat. We need to learn from the Malaysian leatherback situation, the Sarawak green turtle experience, we need to learn from them. Where they have failed to protect the eggs in the early stages, and the population is now in decline. In the US egg harvest is now probably not a problem, but mortality in adults or mortality of adults in shrimp trawl is. So, to conserve their turtles, they need to convince the public that the adults must be protected, because their eggs are already well-protected. They must now convince properly their public that adults must be protected because they have a high reproductive value. Some of the experts cite the work of Crouse that the reproductive value of an egg is 1, and the reproductive value of a breeding adult would be 584. I would like to note that the unit that is used here is in numbers, 1 egg to 584 for the female or breeding adult. Can we use numbers to equate an egg to an adult? In ecological modelling, we have to standardize the unit and we have to standardize in energy units or in biomass, biomass means in weight. So a turtle egg only weighs about 40 grammes, while a young adult female will weigh 60 kg, which is about 1,500 times the biomass of an egg. So when we standardize reproductive value in terms of biomass, not in terms of numbers, then the reproductive value of an egg is 1 and that of a young adult is 0.4. So using reproductive values is just how you interpret it, but I feel we should interpret in terms of biomass rather than in numbers because we cannot equate an egg that small, with an adult. It is true that the mortality of adults has a very instantaneous impact on the status of a population. Almost immediately you will be able to see the decline of the number of nestings. But the impact on eggs or hatchling mortality will not be obvious until decades later, many years later. By that time it will be too late to take remedial action because the population has virtually collapsed. That's what has happened to the leatherbacks in Malaysia, and [green turtles] in Sarawak. It is like a case of trying to determine which virus is more deadly, the Ebola virus or the AIDS virus. The Ebola virus is a very contagious virus, spreads very rapidly and it kills in a matter of days. But because of that you are able to identify it, isolate it and then take action. The AIDS virus, and its transmission is more discreet, it will take many, many years before you detect it. By that time millions of people are infected. You have to be very careful when you talk about protecting adults or protecting eggs. I think both have to be handled with equal priority. Not just one.

Chairman

184. Do other experts want to take on those points?

Dr. Eckert

185. Just a couple of points. Liew's point taking an example from Malaysia is very good on a number of fronts, not just for the problems sustained by the Malaysians with their leatherbacks which was really, I consider it, through no fault of their own, there was simply no scientific knowledge at the time to suggest that the 10 per cent egg buy-back that they were executing in Malaysia was not going to be adequate to restore the population. And also having worked in Malaysia for some time I have to

say that Malaysia has one of the best conservation programmes for marine turtles anywhere in the world. They have really taken hold of the situation relative to the conservation of their nesting stocks, and done very, very well. It's been a very admirable effort.

186. A quick comment about the reproductive value point that Liew was bringing up. The reproductive value curves, the references they are making to that, is the value of the individual towards supporting the population reproductively. The only time that you would want to use a terminology such as caloric value or something along those lines is that would be more of a fisheries biomass term relative to harvesting the egg or the adult. If you were going to harvest an adult, how much of a protein yield are you going to get? So the reproductive curve is based on the ability of the individual to support the stability of a population. That's why that value is expressed as it is. The models that were done for that are arguably difficult to work with. They are based on loggerheads, and much of the data is on declining population for loggerheads. That's why you see such a wide range. When we say it takes 1,000 to 10,000 eggs to yield 1 adult, it is because of the lack of precision in a lot of those estimates. But what is clear is qualitatively, that it takes a whole lot of production of eggs, because of the high mortality and small size classes to get one adult. That's why we use what seem to be a very broad range of numbers. There is probably nothing to suggest that those numbers aren't within the ball park for all species because we see very similar reproductive strategies across all species. Reproduction in marine turtles is very conservative and so those numbers are probably not so far off for the other species as well. And as Liew well pointed out, we definitely need to take a balanced approach to all of this. The example that I gave in my report of the leatherbacks in Mexico is a very good one. In Malaysia they had an almost 100 per cent egg harvest for many, many years and probably until the mid-1980s didn't have a lot of at-sea mortality, that we are aware of, that we can quantify. There may have been some trawling mortality that Chan and Liew have documented very well but there was also the high-seas driftnet fishery that kicked in in the early 1980s. So that population decline was probably due primarily to the egg taking and it took 40-50 years to actually see it start being reflected in a distinctive manner on the population.

187. In Mexico we have a different situation. The Mexicans have done extraordinarily well at protecting their beaches, they have the marines out there, camped out on the beach to protect their nesting females and their eggs and they have severely limited mortality for upwards of 15 years and maybe a little longer on leatherbacks. Yet we have seen in excess of 90 per cent decline in that population in 10 years. The primary reason for that is that we weren't taking a whole population approach to our conservation. We didn't know that the Chileans or the Chilean and the Peruvian gill-net fisheries were taking large numbers of leatherbacks. And we didn't figure that out until last year when we put satellite transmitters on them. So it is a classic example of being blind-sided from the other direction. It wasn't the egg-take issue, it was the high-seas take. Again it hammers home this point, that you have to manage these populations in a holistic sense, that you have to understand all the sources of mortality and you have to deal with those. Now the conservative approach relative to shrimp fishing is if you have mortality associated with shrimp fishing that you have to fix it. It's the bottom line. How you want to approach that? You have heard quite a bit of variation and I am sure that you are going to have to wrestle with that on your own, but the bottom line is that if you've got a problem, you've got to fix it.

Chairman

188. Thank you very much. Do any of the other experts want to take on these points at this time?

Dr. Frazier

189. In my comments to the Panel, I tried to, in the best terms I could, to simplify this aspect of the concept of the breeding value. This is a magic number, it is not something you go out and measure.

It is a way of synthesizing, in one number, many different aspects in the ecology of an animal. To try and visualize very simply in a column of numbers, this animal represents more in the reproduction and maintenance to the population than this animal in this stage. It is an abstraction, the fact that hatchlings are 1 and breeding females are 584, that can be changed. The hatchlings can be 0.5 if we like. 1 is used simply because that's the unit to start with. It's simply a matter of convenience. The end number will vary from population to population, and will certainly vary within a population through time, depending on how those ecological processes are operating. The reason for doing this is to simplify many different things that are happening in the ecology of an animal, to very simply come up with a list and say this is where there is more importance in maintaining the population. I don't think any sea turtle biologist would recommend omitting protection on all stages. This gets us back to this integrated approach. The way perhaps to use these numbers is, if I protect a handful of eggs, or if I protect one large animal just about to breed, where will I have more value in my population? Although I have lots of eggs here that could potentially become breeders or have an animal here which is just one. By the odds of biology (and biology is not a pure science, its a science of statistics and stochastic processes) this handful of eggs is not anywhere near the value of this one animal by the chances. So if I have the opportunity to protect this animal, my instantaneous response to the population is likely to be much greater than protecting these eggs. This does not mean I should ignore the eggs, it simply means that I should not be deceived into protecting large numbers of eggs is going to give me an immediate response and necessarily going to protect the population. This again takes out of biology into the social sciences. We see this a great deal in Mexico. Scott has mentioned that. There is a big impact politically in protecting eggs because politicians can go to the beach and have their pictures taken, they can be displayed in local newspapers and they can be seen protecting turtles. It's very visual, it's charismatic and that leads us to a danger in focusing and in omitting the other aspect which is not visible to us, and that's what happens in the ocean. At no point in my submissions, and I don't think in anyone here, would anyone want to omit protection of the different life stages. That's not an issue, we want to integrate it. The breeding value is simply an abstraction to try and focus where an individual may have more value. One egg does not have as much value stochastically as one individual which is near to breeding or indeed breeding. That's simply the matter.

Chairman

190. Thank you. Dr. Poiner.

Dr. Poiner

191. The issue of a reproductive value, again I would agree with Dr. Frazier that I don't think there is a lot of argument about the reproductive value of an egg versus a mature female for example. However, I think that in making an assessment of the impact of an activity there is the other part of the equation that needs to be taken into consideration, that's the relative mortality rates on those different stages. And that's invariably done under modelling, in modelling studies, and then you get into, what some would argue into the lap of the gods, because you are starting to make some of the assumptions, and what you find when you actually look at the modelling studies, the differences that are often predicted usually relate to different levels of mortality on different stages fed into the models. Hence the important issue is that there are two bits of data, you need not just the reproductive value data in terms of making those assessments. But I would agree with Dr. Frazier that the important issue here is that you need to focus on the whole population, all sources of mortality and obviously in any management situation, in any population stock, given that you probably won't be able to deal with all of them, you deal with the bigger ones or the most important ones first. Hence it is important to know what they are, and where they're acting and at what stage of the population they're acting.

Chairman

192. Thank you. Dr. Eckert

Dr. Eckert

193. From a management perspective I often argue with resource managers on this. Using these value curves and saying that approximately 500 eggs equal 1 adult turtle, what that also suggests from a conservation management perspective is that you should be able to afford that much more effort to protecting those juveniles and adults. I often hear from managers that it is so expensive to protect juveniles and adults because we have to do fishery modifications, we have to whatever and yet, those adults are worth 500 times more than an egg on a beach. So if you're going to protect your animals you should be allocating your resources in a similar manner and in a world of limited resources, you don't have enough money to do everything, and that's understood. So when you look at these things, you say "OK, how much is it going to cost to protect those eggs on the beach? Yes, I have to do that". And I also have to realize that I get more conservation bank from my buck by protecting the adults as well. So you need to balance it, but also be aware that, yes, it is more expensive to go out there and protect those juveniles and adults, but you're getting a lot more return for that value that you're putting into that conservation effort.

Chairman

194. Thank you very much. Dr.Guinea you had a point on this?

Mr. Guinea

195. Yes, thank you. I'll just make it a comment here. This magic figure of 584 does raise some problems in that it tends to bind us into a set way of thinking. The figure 584 has been produced for computer synthesis. This figure enables certain numbers in certain columns to add up to a certain prescribed number at the end. In the Australian studies of loggerheads, the figure, instead of 584, was somewhere between 200 and 400. And so that's within the same species, be it two different reproductive units or demographic units. So this will change from breeding unit to breeding unit, but its use is just to make rows and columns, add up to suitable numbers. Now whether it is actually viable in the field, in real life, is another point altogether. A conservative approach is that anything that is impacting negatively on any of the stages of the sea turtle life-cycle should in fact be addressed. Now I have mentioned this already. if it's a death through incidental capture in gill nets that should be addressed. If it's a problem of excessive harvesting, then that should be addressed. There are a few advantages in having shore-based conservation activities. These advantages come from community involvement, in that more and more people become involved in the conservation process. If you're going to have your conservation process restricted to the back decks of trawling vessels some kilometres off the coast, the community is not involved in that process. The community doesn't see the process going on, and they may be led to believe that "Yes, sea turtles are secure because we have TEDs on the nets on the vessels that are operating off-shore". I think a better all-encompassing approach is to have the community at the village, state or parish level involved with protecting their turtle beach and having resources put into that to focus on sea turtles and the state of the oceans but not to the exclusion of protecting sea turtles at sea and from various forms of mortality, be it shrimp trawlers or gill nets or whatever.

Chairman

196. Thank you very much. Dr. Liew.

Mr. Liew

197. In general I agree that we have to take care of both, but I brought this point up because there were some statements saying that protecting adults is more important than protecting eggs. We have to look at both, and not only look at both, we have to look at situations, populations. Some populations, you find that eggs are not the problem, you don't really need to protect them, because they are already well-protected. That's why you have to concentrate on the adults. But there are certain other populations where egg harvesting is the problem. So that is where you have to, and in these countries they usually have very limited financial resources for conservation. All conservations have very limited resources for some reason and that is why they have to concentrate more on the eggs because they are really having problems with the eggs. They don't really get enough quota for protection because they are still harvested, legally or illegally or whatever, or even in cases where you have problems of predation so that is where you find that you need to channel your attention to protection of the eggs. And if, of course, adults also have problems definitely you need to. But every population you have to weigh the situation and see which is of more priority and where you should channel your resources.

Chairman

198. Thank you very much. We had an extended discussion from the experts. Of course we'd be happy to go on with that, but I think it might be more efficient if we interrupted it at this stage and allowed the parties, each in turn, to make their comments and put their questions for the experts and I think once we have heard those five interventions that would be a suitable point at which to break for tonight so that the experts can then have time to reflect and come back tomorrow morning with their round of responses. As I indicated earlier we propose the parties to follow the order which had been established in our earlier meetings, which is to say to begin first with the complaining parties, in the order of Thailand, India, Pakistan and Malaysia and then to turn finally to the United States. So perhaps I could invite the Ambassador of Thailand to give his comments and questions. You have the floor.

The Ambassador of Thailand

199. Mr. Chairman, I really appreciate the chance to appear before you again and to witness this very interesting conversation this afternoon. I must say from the outset that as you know I am no expert in shrimp and turtle apart from a great lover of turtles and of a fond eater of shrimps. So I find this discussion this afternoon extremely educational and interesting. It reminds me of the first morning that we brought this case to you Mr. Chairman We were very concerned and very worried about the time and effort that we should put in. But I think that it is more than compensated by the knowledge that we have gained today. Well, I'd like to say given the fact that I am no expert on this, and given the complexity of the matters at hand, and given the fact that we have a very high quality discussion by the experts this afternoon and they also show a high degree of professionalism and professional ethics, I have not much to say this afternoon. But I would certainly like to reflect upon what has been said so far by the five experts and I shall come back to you tomorrow. I would like to consult with my expert back home. I simply would like to say that, number one is to thank the experts for their input because you have worked hard to answer all these questions raised by the Panel, and we have made our comments to your responses and I think that I don't want to repeat them here today or tomorrow. Secondly, I must say that we appreciate not only your effort but we have learned a great deal from what you have said in your written responses and from your intervention this afternoon. I only hope that we would have a better understanding of this very complex matter so that both the conservation and the enforcement could be better done to the benefit of all. I think I will

leave it at that, I thank Mr. Guinea for pointing to the Thai TED. I think it looks better than our Thai financial flu which is floating around over there!

Chairman

200. Thank you Mr. Ambassador. Perhaps I could now invite the representative of India to put questions and comments on behalf of his delegation.

The representative of India

201. The issue we are looking at today is sea turtle conservation problems and that is the purpose of this meeting and before I express any comments or views on this, I would like to take this opportunity to thank you and the experts for having provided us and my delegation especially with such an enlightening experience and of course to say that, since that this is the first meeting that we are having in the New Year to wish all of you a very happy and prosperous New Year. Having said that Mr. Chairman, our delegation has no specific question to put to the experts. We have heard with a lot of interest the view that sea turtle conservation has to be looked at in a holistic manner, in an integrated manner. It is something that we ourselves are very much committed to and have worked at actively towards promoting in our own way and I think I should just stop there and let the work carry on. Thank you.

Chairman

202. Thank you very much. Perhaps I could now turn to the representative of Pakistan.

The representative of Pakistan

203. Thank you Mr. Chairman and I am extremely grateful to you for this opportunity and my delegation owes a debt of gratitude to the worthy experts for their very enlightening comments. In fact for me this is the first lesson in marine biology and certainly I need a little more time to reflect on what they said, but I greatly appreciate the kind of very knowledgeable comment they made on various issues. Thank you Mr. Chairman.

Chairman

204. Perhaps I could now turn to the representative of Malaysia and invite him to make whatever comments or questions he might have.

The representative of Malaysia

205. Mr. Chairman, thank you very much. I, like the rest of my colleagues around the table, would like to thank you Mr. Chairman, members of the panel and our distinguished experts. I too do not profess to be a turtle expert, being a trade man, I found these discussions extremely enlightening. One thing I definitely learnt is that there is no single prescription to an illness, it all depends on the degree of the illness. I would like to take the example of having the flu. If it is a simple flu, you just take a Panadol, but if it is a bad case of flu, then you go for antibiotic or maybe even a jab. The point that I am trying to say is that one thing I learnt today is that conservation takes many different aspects and methods of conserving turtles. Mr. Chairman, Malaysia has already put in its questions in writing yesterday.

Chairman

206. On that point you are referring to the questions that were included in the written comments on the reports that we had from the experts. Perhaps we could invite the experts tomorrow to address those points.

The representative of Malaysia

207. Sure, Sir, and we would also like to reserve our right in the event that we would like to come back to any further questions.

Chairman

208. I think that concludes the points from the complaining parties, although I note that there may well be the possibility of further questions tomorrow, additional to the ones that have already been put forward by Malaysia. There will no doubt be time for those, if anything further eventuates. Can I now turn to the United States and ask if they have comments and questions that they wish to put forward?

The representative of the United States

209. I first want to thank the Panel for again coming to Geneva for this very difficult case. I want to thank also the Panel and the parties and the experts for trying to accommodate our scheduling requests and I know that our delegation spoke to all of the parties and they all agreed to our request. Unfortunately, we still couldn't get it right it quite right, Mr. Balton was not available to come, he sends his regrets. Of course I'd like to thank the experts. They did an outstanding job of a massive amount of information and a very limited amount of time. I think they've done Ph.D thesis in a few weeks.

210. Just a preliminary comment on the procedure. Pakistan presented all new facts, basically responding on their own respect to the questions and Malaysia in its brief also presented new facts. It was a new conservation programme involving different coloured boats and different exclusion zones which wasn't present in their prior briefs. We are not commenting on that, we understand that there is not the time for new information but we would ask if that is something that the Panel wants to consider, that we of course be given a chance to respond to it. We also have developed a list of questions which I could read to you now, or else Mr. Andersen was suggesting that we could also type them up very quickly and fax them tonight if that would be more convenient or I could do both.

Chairman

211. I think if you have them available in writing, I think it would help everybody and save our time now. If you could just read them out, they would then be read into the record and then tomorrow they could just be answered. If we could have the written version tonight, that would be helpful for the experts to prepare their answers.

The representative of the United States

212. There's been some dispute among the experts about the recoveries of various populations and even about whether one can define various populations. Our question about that is, leaving aside the specific populations and in particular the Malaysian Sabah Turtle Island populations which is much discussed, aren't there other sea turtle populations found in each of the complainants waters that are members of populations which are not yet showing signs of recovery? Further, if such sea turtles

suffer incidental mortality in shrimp trawl nets, wouldn't this contribute to the endangerment of sea turtles?

213. This is a question, referring to Mr. Guinea's response and also to the other experts as well. Mr. Guinea performed a calculation based on the reproductive values of sea turtles and concluded that the annual mortality of 5,000 sea turtles from Gahirmatha was "relatively minor". It was not clear to us reading that, whether that was intended to be an analysis of threats to Gahirmatha or merely a hypothetical example. In any event, could the other experts comment on whether shrimp trawling on that level would be relatively minor, shrimp trawling mortality would be relatively minor off the coast India?

214. All the experts have noted various causes of sea turtle mortality, including mortality on the beaches and due to incidental mortality in shrimping and various fishing operations. Our question is: does the existence of all of these threats to sea turtles make it more important or less important to prevent sea turtle mortality in shrimp nets? In other words, I think we have to go to the analogy used by Mr. Liew and also by Malaysia. If the patient comes in with a heart condition and a kidney condition and a lung condition and the doctor says we should treat all three because the patient is seriously ill, is it appropriate to say well don't bother treating the heart condition because there is also two other serious conditions.

215. I think I have heard the answer to this, but it is important to clarify. Do the experts agree that TEDs, when, properly installed and used, reduce the mortality of sea turtles in shrimp trawl nets? Related question: if all the world's shrimp trawl fleets used TEDs, would this contribute to the reduction in the threat to sea turtles? Note that we are not asking whether TEDs would be sufficient, but whether they would contribute to sea turtle conservation, whether it would help. We are also not asking a sociological question about how TEDs should come about to be used, about whether it should be voluntary or mandatory, but just the scientific question, that if TEDs were used properly would it help sea turtle conservation.

216. This is a question to Dr. Eckert: there is a comment in your answer that seasonal migrations would not be expected in regions with warm waters. I think there is some confusion about what that meant. I think it would be helpful if that statement could be clarified. Question to Mr. Poiner. In his statements he noted that 6-8 years would be helpful for the adoption of TEDs. We have also heard talk that the Thai TED is very effective and in fact beautiful and apparently was adopted in just a matter of months or for about a year. We would just like the experts to discuss that. Question to all the experts, Mr. Liew in particular: there has been a lot of talk about beach conservation versus conservation of adult turtles. Our question is would the use of TEDs exclude the adoption of beach conservation programmes. Is there some reason why a country can't do both? Question to all the experts: both Dr. Poiner and Mr. Guinea mentioned time and area closures as helpful approaches to sea turtle conservation. Could the other experts comment on this and in particular address whether sea turtle mortality remains a problem in areas where and during times when shrimp trawling is not banned?

217. Follow-up question. I believe Mr. Poiner noted that there was contemporaneous monitoring going on in Australia which helped these bans and whether that same monitoring is used in any of the complainant countries. Follow-up question to that is also about "hot spots", whether we have enough science to really select all of the hot spots where sea turtles and shrimp trawling might interact. Mr. Chairman, I hope that would be most of my questions but I hope that we would be able to reserve our rights to ask a few more questions tomorrow because we've heard a lot today.

Chairman

218. Thank you. I note then that there will be the possibility of further questions tomorrow from at least three of the participants. Meeting adjourned until 9.30 am. tomorrow.

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Mr. Chairman

219. Last night, just before we closed the meeting, the US asked to have the opportunity to respond to any material that was contained in the comments from the parties on the expert's reports. Any material that was either further argumentation or new evidence that had not been produced at the previous meeting because we had at that time closed off the process. I would just like to recall in this context the opening remark I made at the beginning of the session yesterday, which was to the effect that it's not the purpose of this meeting to hear further argumentation or new evidence, that the process was really intended for hearing the experts, and questions and comments to the experts and I added that the Panel will not take account of interventions outside this framework. That also was intended to apply to the documents submitted prior to this meeting as well. In other words, to the extent that they fall outside this framework, they will not be taken into account by the Panel for arriving at our conclusions. So, for that purpose we don't see that there should be a need to respond to it at this stage.

The representative of the United States

220. Thank you Mr. Chairman we are certainly comfortable with that, we were just then expecting none of these new arguments would be reflected in the descriptive part of the Panel's Report. Is that correct?

Mr. Chairman

221. No, that is not quite. The documents have already been submitted and everything that would be here will actually appear as part of the record. What I'm talking about is what we're actually going to take account of, as opposed to what we are not going to take account of, and that fact will be mentioned in the descriptive part. Is that sufficient?

The representative of the United States

222. That's fine, thank you.

The representative of Malaysia

223. Mr. Chairman thank you very much for giving us the floor. We have just heard what you have just stated and we will certainly adhere to that decision. But just for the record, yesterday the US had stated that Malaysia had in our comments introduced the new facts and I think we would like to be given the opportunity to respond to that. Can we do that now or later?

Mr. Chairman

224. You mean you wish to point to the document to which bits you consider are or are not. By all means, please do.

The representative of Malaysia

225. Malaysia's comments on the "zoning of trawling activities in Malaysia" as per paragraph 1 of our comments on responses of experts [Section V, paragraphs 5.313-316] is not a new effect. The comments are an amplification of what we had stated earlier in our submission, i.e. Malaysia's second submission, answers to questions posed by the Panel to the Parties, in answer to question 27, paragraph 10.7 to 10.8 at page 14 and is a response to Annexes I and II of Mr. Frazier. Thank you.

Chairman

226. Thank you. The Panel takes note of that remark. Passing on, perhaps we can now go back to the questions that we were last night gathering from the parties to put to the experts this morning. We had some questions that were included in the Malaysian document. These are the ones after page 20 headed "Questions to the Experts". The first four were for Dr. Eckert and the other six were for all experts. We also had questions from the United States which have since been confirmed and circulated in writing, I hope everybody has those. There are eight of those questions. There were two other parties last night who indicated that they might possibly have questions this morning, can I inquire whether that is so on or not. Malaysia?

The representative of Malaysia

227. Not at this point Sir.

Chairman

228. Can I ask the Ambassador of Thailand whether he is likely to have any questions this morning?

The Ambassador of Thailand

229. I am working on one or two questions, Mr. Chairman, and I will let you know as soon as possible.

Chairman

230. Thank you. Very well, in that case we will proceed to ask the experts to respond to the questions that are already there, that's to say the ones that are in the Malaysian document and the US questions and, as yesterday perhaps, I can give the floor in alphabetical order to the experts to respond to these. You have the floor Dr. Eckert.

Dr. Eckert

231. Thank you. I guess I'm starting here with the questions from the Malaysian Delegation.[1] In answering to the first question about the hypothesis of migrations relative to joint jurisdiction by the United States and the country of Malaysia, I have presented the data that I have used to construct that hypothesis yesterday during the presentation. I feel very strongly that the hypothesis is very well supported actually by the scientific evidence available. There may be some question as to its publication status and whether it is in press, some of it is in press currently and I have to say that the information is so recent - this tracking study in the Pacific is currently ongoing - and it will probably be a matter of at least two years before that project is in a position to publish that information. So,

[1]See Appendix 1 to this Annex.

you will need to take the information as I present it as a scientific expert as it stands. As I said before I do believe that hypothesis is quite well supported. The other issue I presented yesterday was that there is a potential for cross jurisdictional relationship between Malaysia and the US in the green turtle populations as well. Guam and the Northern Mariana Islands do have green turtle populations foraging and nesting. There is actually a nice little nesting population in Tinian of green turtles who are well within the migratory distances travelled by green turtle females post-nesting and that certainly does not even include juvenile foraging habitats or juvenile migrations which we know so much less about. So I think there is good solid evidence to propose that there is a possible joint jurisdiction between Malaysian leatherback and Malaysian green turtles stocks. That's the basis of that answer.

232. The answer relative to rates of turtles strandings where TEDs are currently required. I don't have a lot of information on that. Probably the best study to date that I am aware of is that by Crowder et. al., showing that in actual use, if I remember correctly, there was a 44 per cent reduction in strandings due to the use of TEDs in shrimp nets. Relative to the relationship between turtle strandings and shrimping activities in the reports, such as that on sea turtles that has been described here, you have to remember that it is something of an ongoing discussion on that information. The information at this point can really be considered quantitatively factual. What they are basically seeing is that their strandings do continue and the question is why are those continuing. Is it an enforcement issue, is it an issue of TED design, is it an issue of closure areas, is it an issue of pulse fishing - this is one of the things that Jack Frazier described in his report. There is also some possibilities, there haven't been a lot of tests done on a CPUE basis so there is some question that there may be continued strandings simply due to the fact that populations are getting larger out there. The fact that turtle excluder devices have gone into effect have meant that some of these populations are showing a relatively nice response and if you have efficiency of 97 per cent and you have 3 per cent of the turtles still getting captured, which is what TEDs are supposed to do, 3 per cent may represent a larger number in real numbers just based on that fact there are more turtles out there to catch. So there is a number of things ongoing in the debate, that's why it is posted on something like CURTLE which is a discussion network for sea turtle biologists.

233. In question number 3 relative to the leatherback population on St. Croix. The St. Croix project was indeed a nesting beach project whose goal was to try to enhance the leatherback population nesting at St. Croix, to the use of conservation measures on the beach, including egg relocation and active protection on the beach. This is a programme that my wife and I started back in 1981/1982 and one of the reasons that this programme was undertaken is that there was an identified source of mortality. There was an issue of possible beach development and then there was an issue of identified mortality of eggs due to poaching and, even more significantly, due to loss of the nests due to erosion. In the first season down there, we documented 65 per cent of the eggs were lost annually simply to natural erosive processes. So, our response as a conservation measure on that beach, was simply to relocate eggs to safer areas and thereby boost egg production substantially over what had been historical levels. Now, there is the current nesting population size, which is somewhere in the neighbourhood of a 100 females, and one of the questions says, would you say protecting nesting females on the nesting beaches and protecting eggs undergoing incubation had contributed towards the build-up of the nesting population in St. Croix? At this point, it is still too early to say. The population has been showing a slow but sure increase over the last few years and we are very encouraged that it may be providing support to the population. After all we have been doubling egg production on that beach since about 1982, so that has been a significant increase in the number of turtles being put into the sea.

234. Question 4 is actually a comment not a question so I will leave it at that. Do you want me to get into all the expert questions as well here? I will just race through them. In your expert opinion

would trade prohibition on the import of shrimps to the US save sea turtles from shrimp trawlers and extinction? [Question 5 by Malaysia] Certainly. I think it would cause a net benefit to sea turtles. Any time you can reduce the number of turtles killed in shrimp trawlers you are going to benefit the populations, its relative to the trade prohibition. Let me just briefly describe a situation that I witnessed in Trinidad, a country in which I maintained an ongoing research programme for about the last five years. I am going to have a difficult time with the factual information here because, again, I am just pulling this off from my own experience and memory, I am sure this can be documented. A couple of years ago Trinidad was embargoed for failure to maintain shrimp trawler TEDs in their shrimp trawler fleet. The effect in Trinidad was extraordinary. I was down there just after this embargo had gone into place and the price of shrimp had dropped out of the market. The local market in which you could barely buy shrimp in previous years was flooded with shrimp and the value had gone way, way down. Clearly the impact to the shrimp fishery had been economically very significant. The response by the fisheries management agency in Trinidad was also extraordinary. In previous years, there was a bit of a jurisdictional split, turtles were jurisdictionally managed by their Wildlife Section under the Department of Agriculture and the Fisheries Department is a separate department and they had virtually ignored any of the requests from the Wildlife Section to support sea turtle conservation or minimise take in the fishery. Subsequent to the embargo the Fisheries Department immediately called the Wildlife Section and requested a biologist to come with them and advise them on what they should be doing. So Wildlife sent one of their sea turtles biologists over to work with both the shrimping fleet and the Fisheries Department and TEDs were put into place in a matter of months and it was an extraordinarily fast turnaround. So, relative to the effectiveness of the embargo in supporting the conservation of green turtles, my experience is that it was extremely effective in Trinidad and it was just a matter really of the Fisheries Department recognizing the need for this and taking steps to have the process occur and believe me, it did not take very long at all for them to get out there and start making sure that these devices were being utilized.

Chairman

235. Can I just confirm that your answer to that question is that a US trade prohibition would by itself, on its own, without any other measures, save sea turtles from shrimp trawlers and extinction? I just wondered whether that was the question you were really answering.

Dr. Eckert

236. Yes, I'm sorry I didn't see the "by itself" and in response to that, no. Certainly, what we have talked about extensively yesterday is that you need to take a multiple approach to the conservation of turtles addressing specific problems. I guess what I was interpreting this to mean was that, would it help to save sea turtles and the answer to that question would be, yes it would, as opposed to by itself, no it would not.

237. "What is the acceptable recognized method of determining population size of breeding units? [Question 6 by Malaysia] I am not sure that there is a complete consensus on this, but what I have stated in my response to the Panel was that the general consensus among biologists, at least among the biologists that I have spoken to and worked with, are that you need to monitor the population for a number of years. You need to monitor the number of nesting female for a number of years before you will be able to determine the trend. What I have suggested is that the time period needs to be approximately 3 migration cycles. The average re-migration cycle is defined as the number of years that the average female within a nesting aggregation takes between nestings. Now, in Australia, if I understand Colin Limpus' work, that is often 5 to 7 years, in the Caribbean where I have substantially more experience, it is 2 to 3 years. So it can vary depending on the individual region as to how long you need to monitor that population. It also depends somewhat on the species, in that olive ridleys and Kemp's ridleys often have annual nesting events and, thus, the annual average re-migration rate

can be a single year thereby, (by the way I am using the calculations), 3 years might be adequate to indicate a trend for those nesting populations. Having said that, you have to realize there is a tremendous amount of variation in this depending on other environmental external factors, such as southern oscillations. Colin Limpus' work on green turtles has specifically pointed that out that the El Ni_o or the southern oscillation in Australia has a large impact on the re-migration rate of those animals and that their re-migration rate can change based on what's going on out there in their particular world, particularly relative to food availability. That is actually somewhat significant over the last few years, it is going to be interesting to see what has happened in the last 10 years in the green turtle populations of the Western Pacific because we have seen an increase in the rate of Southern oscillation events over the last 10 years. That may very well explain issues relative to a shifting, there may be a shifting in the re-migration intervals and in those populations. The best folks to speak to that are obviously the Australians who work on the species and have been able to document this very well.

238. "Please tell us your views of the concept of unit stocks or populations of breeding units and sea turtles". [Question 7 by Malaysia] We have worked this pretty heavily over the last day or so. There is no question, in my opinion, that the identification of unit stocks is an extraordinarily important management tool for marine turtles. It will be the tool by which we can apply proper management to sea turtle populations in the future. As I was the Chairman of the US Pacific Sea Turtle Recovery Team, that developed the recovery plans for the Pacific for the United States, and in those plans, we were all in uniform agreement that one of our top priorities is to see the stock ranges of all sea turtle nesting aggregations identified. However, what I would also like to say, is that currently we do not have enough information on those stocks and on those stock ranges to use it as a management tool. It is simply a goal that we are working very hard towards obtaining and it will be a number of years before I feel that it is adequately documented to become a useful management tool. This is why I have advocated an approach more of, when you see a problem with the sea turtle population due to, say, incidental take in this case, that you address that problem irrespective of individual stock, quantities of individual stock status. We simply do not have enough information on individual stock status to warrant the approach that says we do it stock by stock. So, if turtles are taken in shrimp trawling, I feel very strongly that you must address that issue immediately and not wait another 10 or 20 years until you can identify whether it's important to that particular population or not. There is enough evidence out there on the impact of incidental take on turtle populations, in populations that have been better studied, to indicate that the problem probably exists globally. "When studies on a particular sea turtle population are made, will the results applied to populations being studied?" [Question 8 by Malaysia] I think I have just covered that question as well. "Would you say that there are sea turtle populations in the world that are quite healthy?" [question 9 by Malaysia] I have a very difficult time saying that. Based on my experience it would be very difficult to say that there is any population of sea turtles that is quite healthy. You have to sort of look at the historical context of a question like this and the question sort of comes back to, do you want to back to 200 years, 500 years or 1 million years, as to how you answer a question like that. If you go back a million years obviously no, if you go back 10 years, there is some encouragement in a few populations that there may be something other than remnant populations. Otherwise I cannot be encouraged with our current status, even in the last 30 years that we see any population that could be considered healthy.

239. Would I agree that "loggerheads are the most vulnerable to shrimp trawling?" [Question 10 by Malaysia] The question "are they most vulnerable", all sea turtle populations are vulnerable to shrimp trawling. In the United States there has been some discussion about whether leatherbacks can be subject to shrimp trawling. In the United States and the coast of Georgia, North Carolina, there were large numbers of leatherbacks killed in the shrimp trawler a number of years ago and that number seems to fluctuate quite a bit probably based on what the migratory pathways the

leatherbacks are on at the time. Basically, my feeling is that if you have a habitat in which any species of sea turtle and shrimp trawling occur you will have significant mortality of sea turtle populations. I think this is the way in which this thing has to be examined. If there are turtles there and shrimp trawling there, there will probably be mortality to the sea turtle populations. Thank you.

Mr. Chairman

240. Do you wish to address the US questions as well?

Dr. Eckert

241. Let's look at question 1.[2] I think a lot of this has been pointed out fairly clearly in some of our previous discussions and previous answers. Jack Frazier has brought up Indian Ocean turtle populations and the declines in some of those, I hope I am not speaking out of term for Jack. Certainly, the leatherback turtle population of Malaysia is not in recovery. The green turtle and hawksbill peninsular populations, I believe, are also in decline for the hawksbill of Malaysia. I am not sure what the status is of turtles in Thailand other than what we have written down. I am going to pass on with that question, it's probably more than I can try to answer at this time. I am going to let Mr. Guinea deal with Question 2 because it is really addressed more towards him. I have stated in my response that I think that the annual documented mortality of 5,000 turtles nesting at Gahirmatha is not minor. It probably represents quite a bit more than that. I think that the Murphy's study on what percentage of the turtles actually make it to shore after being killed in a drowning incident suggest the number is probably substantially higher than 5,000. But shy of getting into a numbers game on this thing, which I am not really equipped to do right here, I don't want to go any further than that. Question 3, "... does existence of all these threats to turtles make it more important or less important regarding turtle mortality in shrimp trawlers?" I guess, what you have to say about this is, I get back to this point. Mortality in shrimp trawling is a documented fact in a number of areas and in other areas it simply isn't documented. There are a few areas where it simply isn't documented. In those areas where it is documented, we obviously need to address the shrimp induced mortality on turtles. Areas where it is not documented, we need to use our best judgement to indicate rather there are turtles and trawlers working in the same habitats and if there are, one has to assume that mortality is going to be associated with that. That's my own opinion on that. "Do experts agree that TEDs that have been properly installed and used reduce the mortality of sea turtles in shrimp trawl nets?" [question 4 by the United States] Yes, I don't think there is any question there. "If all the world shrimp fleets used TEDs would it contribute to reduction, to the threat of sea turtles?" [question 5 by the United States] Yes, in my opinion it would. Any time you can introduce something that reduces the mortality of wild turtle populations, which are in trouble obviously, it is going to help.

242. Time and area closures: this is more of a management type question and it's a difficult one to answer, just simply from a science perspective, it is one that managers need to address but there have been problems with time and area closures in the US experience that I am familiar with. Primarily, I think that one of the most significant sources for the problem are that if you are using a time closure or a time and area closure; we are closing a particular area for a certain time. Very often it is difficult to respond to the turtles changing in their patterns, of either movements or migrations. We saw this in the US when, for example, leatherbacks started moving in closer to the coast than they had in previous years. During times of the year when turtles normally would not necessarily have been an issue in those waters, the management agencies had a difficult time responding by putting the regulations into place, by banning shrimping in the area. So, unless you close an area pretty much all the time, which is often very unpalatable to the fishing industry, using a time and area closure is often

[2]See Appendix 2 to this Annex.

very cumbersome. I think in the case of the US, and I don't want to try to speak for the Fishery Services on this because this is their business, but it does seem to me that after a number of years of experience of trying to do time and area closures they realized that it was far simpler, from both an enforcement perspective and a management perspective, to simply require turtle excluder devices all the time so that they didn't have to try to deal with the vagrancies of the biology of the animals which we well pointed out that we don't understand very well. It also meant that they did not have to be confusing the fishing industry with closures on, closures off, closures on and continuous monitoring of what was going on out there relative to the turtle take. I think time and area closures can be a very very difficult from a management perspective and not necessarily well received by the fishing industry because it puts them in a source of confusion to know whether they will be able to fish or not. Most significantly when they are done they cannot be static they have to be plastic. All of a sudden you have got turtles in the water, you must call up the fleet and tell them to shut down. If you are not willing to do that, then time and area closures will not be effective for turtle populations, they simply move around too much.

243. Let's go to Question 7, "could Dr. Eckert please elaborate on his statement of 'seasonal migrations will not be expected in regions of warm waters'". I made that statement because in the discussion on migration in sea turtle populations. What we see, and it is based partly on my experience on the US West Coast and what I know about information from the US East Coast. One of the primary things that we look at, when we look at the presence or absence of turtles particularly on the West Coast, is water temperatures. There have been some nice studies done that indicate in the West Coast that turtles follow the 18 degree isotherm, at least the hard-shelled turtles, what we call the Thecate turtles, which are the greens, hawksbills, loggerheads. When the water temperature comes up to 18 degrees, turtles start moving in. Some satellite tracking studies I have done on an eastern specific green turtle male, which is actually quite unique (not a lot of work has been done with male turtles), showed that that animal very much preferred water temperatures at 22 degrees and he seemed to move to make sure that he was within 22 degrees. He was vertically in the water column, or horizontally, depending on his location. This was tracked up the US West Coast. My statement relative to that is that temperature can be an indicator of either biological factors that the animals are moving for, or simply physiologically what the animal needs. So that is the primary reason for turtles moving. My reason for saying that I did not expect to see that kind of behaviour in countries of the Western Pacific particularly is due to lack of knowledge about temperature structure there. I feel that I don't believe that they have those kind of temperatures they get down into areas in which the turtles will move out. My colleagues from there, particularly Liew from Malaysia, could probably answer best on that one. That is how that statement was generated, I guess I was suggesting that, what I had seen, was true for turtles in areas where you have temperature fluctuations. Leatherbacks, on the other hand, are not quite as temperature prone. Leatherbacks have been seen swimming around icebergs, they can deal with very very cold waters and are considered a north temperate species in distribution. Some of my satellite data is beginning to indicate that they are far more cosmopolitan than we ever realised before. However, on the coast of California and the West Coast of the United States, we do see a relationship between temperature and the distribution of leatherbacks probably based on water mass movements. When our temperatures get above about 16 degrees we see leatherbacks start moving into Californian waters, but they are coming from off shore and what they are usually following is often water masses that are coming in. So there is some suggestion that it may be not necessarily temperature related but water mass movement related. Based on what my satellite tracking data shows, what is probably driving things, that an overall desire to move for leatherbacks is based on food availability and where that food is going to occur. So, I guess what I would do is make a statement that temperature does seem to affect the seasonal migrations and movements of turtles in habitats in which they see those kind of temperatures and this is irrespective of nesting females who have their own thing going relative to the nesting season.

The representative of the United States

244. Mr. Chairman, I just want to clarify the question. The season migration we are talking about here is not the same thing as what Dr. Liew was talking about, when the turtles have one place to nest and one place to feed and they go back and forth. They are different things, is that right?

Dr. Eckert

245. Thank you. Yes, that is exactly what I am trying to point out. We need to separate the kind of migration that I was talking about here which is seasonal migrations, from reproductive migrations. This refers very much more to say, juveniles or non-breeding females or non-breeding males relative to migration. Now, on reproductive migrations yes, that has been much better defined. There are these reproductive migrations and you have to realize that most of our research has been very myopic when it comes to sea turtles. We have looked at reproductive females, it is sort of the equivalent to martians studying humans by studying them in the maternity ward. It has left big gaps in our understanding about the biology of these creatures and we are having to address those issues now, because what we are finding is that the other 99 per cent of their lives are significant to the overall biology of the species. So, yes, I am primarily addressing non-reproductive migrations. One final note about reproductive migrations is that males also seem to exhibit reproductive migrations though they are much more poorly defined. "The adoption by TEDs of shrimp trawling would take between 6 to 8 years, could experts comment on this point?" [question 8 by the United States] Yes, I have some experience in the history of how they were put in the United States, just having been in Georgia for ten years during some of the early years of the implementation of the use of TEDs. A lot of the problems were simply problems of introduction. I think a lot of those problems have been solved and I would say that 6 to 8 years may be a little longer than is absolutely necessary but, as we talked about before, a lot of this depends on the sociological factors associated with the particular industry. In Australia, they seem to have a very good cooperative relationship with a relatively small industry. In the United States, you had independent fisherman working in their own boats and their own areas and a very large fleet, certainly the number of vessels operating there were numbering in the thousands, in Australia it is numbering in the hundreds. So, there are a lot of those factors that have to be brought into play: of how easy it is to work with the fisherman, how easy it is to teach them how to use these and I would have to say that if Mr. Guinea feels it would take 6 to 8 years in Australia, it very well might. Although Mr. Poiner certainly has more expertise there than I would. But, in the US the long duration that it took to introduce was mainly because it was the first time that anybody tried to put something like that into place with a fleet of that size and there was simply a long learning process on how to introduce it. I think that in the last few years they found that the optimum way was simply to require it and go from there, it has been a lot more effective. So, I will turn it over to Jack. Thank you.

Dr. Frazier

246. I will start with Malaysia then. Just passing very quickly over the first questions directed to Scott. The question of jurisdiction, although this is not directed to me, I feel that this concept is very important. When turtles are on the high seas outside the EEZs of any country, they are on the high seas in the commons, in the world commons, and I think that is one of the reasons why sea turtle biologists often speak of this as a global resource because at that point any nation can have an impact on it. Clearly, they are not under the impact of trawlers out there, trawlers do not work in the high seas, but they are a global commons when they are in that part of their life stage. As a concept in conservation biology, when you have a charismatic flagship species like this; my hope is that it will draw nations together to collaborate in the conservation of these shared resources, whether it is in shrimp trawling or high sea drift netting, long lining or whatever. Just that point to me is very important as a strategy in conservation.

247. The first question [by Malaysia] to all experts. Using TEDs won't grow more hair on my head, I won't have more girlfriends, it won't solve the problems of poverty and suffering on the planet. But using TEDs will contribute, if they are correctly done, to reducing sea turtle mortality and will be part of an integrated approach to conserving a very complex resource. I don't think it is useful for us to go to extremes and say what is the greatest, what is the smallest, by itself will it do this. I don't believe we can effectively conserve a complex resource by limiting our vision to something like this. It would be the same as human health, you would not raise a child by just giving it rice, you have to give it other sources of food, you have to give it love, education and so forth. So, the rice is necessary but it is not sufficient alone. By itself, it is not enough but I do not understand why we should consider that by itself.

248. The question of population size, breeding units or management stocks [question 6 by Malaysia], I tried to address that in my comments. It is a source of discussion because we are just beginning to understand this with sea turtles. If they were white rats or squirrels or lizards on a wall it would be much easier for us to manage them because we could understand these animals with much simpler investigation. With animals which take decades to reach maturity, which live for long periods, to maintain their populations must breed for long periods, which move about the world's oceans, some of them more than others, it is very, very difficult to understand just what a breeding unit is. To determine the population size in normal population biology means everything that is part of a breeding unit, a management stock from the very smallest animals to the very largest animals; I tried to address this in my comments, and I hope I have been clear. The trouble with sea turtle biology is that most, all of our work is limited to the beaches because it is easier to get to beaches. Biologists will be constantly complaining that we do not have enough funds to do what we need to do. If you have to work on the high seas it is much more expensive, it's much more complex but that's where the turtles spend 99 per cent of their lives. Most of what we know about sea turtles is from what they do on beaches. Therefore most of what we can do in terms of estimating population size is what happens on beaches. This is why we see graphs of egg production or graphs of numbers of nests or graphs of number of females. That's where we have the best idea of what's happening. This is not a complete idea; it is an index of what is happening. In that respect we must be very careful, because the number of eggs produced on a beach represents a number of phenomena which are subject to variation. The number of eggs in a single clutch will vary from female to female. Each female will lay a number of clutches in a season, that number of clutches will vary between females, between species, between populations and indeed between years ... [tape turnover] ... This is then an indicator of the number of females that nested in that year, but it has to be looked at as a very sloppy indicator. You cannot just take one number and divide it by the number of eggs to get to the exact number of females that nested in that year.

249. Indeed, if you could note a number of females that nested on a beach, all the females that nested on a beach in a single year, that only tells you the number of females that nested in that year. That doesn't tell you the number of females in the population, nor is it simple to take that number and estimate the total number of females in the population. The numbers of females every year can vary, there has been some very dramatic changes in numbers of females nesting in a single year from work done in Australia. There is an island called Raine Island, my colleagues from Australia can, I am sure, explain this much better than I can, but in Raine Island they cannot count the number of turtles in a season for a number of reasons. The first reason is that it is a remote area and it is difficult to get to; the second is that the density of turtles is so great that it is almost physically impossible to count them. It is like Gahirmata in India, or some of the nesting beaches in Central America. It is physically impossible to count the turtles, there are so many. As I recall in some years they have had in a single night in excess of 10,000 turtles in a single night, and then the next year the greatest number of turtles nesting in a single night, several hundred, I believe. So, what has happened? Why are the turtles

doing this? Does it mean they have all gone extinct? No, these are tremendous fluctuations. In Australia, they have good information which shows this is relevant to the southern oscillation and there seems to be a relationship to food availability. In other areas we are much more ignorant, we do not know what is happening. We still have these fluctuations. I have tried to address this also, I have tried to include scientific references which deal with this. Green turtles are famous for this but other species also show this. So it is very very difficult with our information to be able to estimate what is the size of a population. With long-term data, Scott Eckert prefers to use an indication of generation times, or maturation times, or re-migration times to give an index of what length of time we need to monitor. There are other people who would simply say we need 10 or 20 years. The point is we need many years of information with these long-lived animals, and this in fact is not something unique to sea turtles, it is something that in biology we have begun to realize that problems of scale are tremendously important. If we are going to understand biological phenomena, we are going to need to understand the tremendous fluctuations that happen in the living world. So I am not sure whether I have done anything more than confuse you with this, I'm sorry if I have done that because I myself am confused, this is very complex. We need to have better information here, clearly we need it, but at the moment at least I consider myself to be terribly ignorant with this topic.

250. "Please tell us your views about the concept of unit stocks or populations or breeding units of sea turtles". [question 7 by Malaysia] Well, this touches back on what I have just been mentioning and what I would add here is something which, especially in fisheries biology, I believe now is an international accord. Certainly, I hope it becomes much much more talked about, and this is the precautionary approach. This is well described in the FAO Code of Conduct for Responsible Fisheries. In simple terms, the precautionary approach is, if we don't know enough we have to be careful. Especially if we are managing resources which are shared by many different people and on which generations of people will depend. The history of the world shows us that, we, as a species, independent of which nationality, have not been careful. The status of fishery stock shows us that we are in a desperate situation. We have to be more careful with the way we manage fishery stocks. Sea turtles are impacted by the way we manage fishery stocks. That is my concept on it. As I mentioned in one of the letters I wrote to the Secretary, if this was as simple as rocket science we could give you straight answers. It's not as simple as rocket science, it's much more complex. "When studies of any particular sea turtle population are made with the results applied to the population study or whether you as a scientist generalize your data, for all sea turtles irrespective of the species...". [question 8 by Malaysia] No, I would not generalise to all species nor to all populations. Indeed, I would say the data I have found are relevant to this population for the time when I was studying it. That is careful science. However, if I don't know enough from another population or from another period or from another species and my level of ignorance forces me to admit that I don't know and I'm forced to take a decision to protect that species, I then have to start grabbing the best information I can find, and I then grab at the closest I can find which is comparable. If that means that I don't know enough about migrations and I have to go to another ocean basin to say, well, I know that this species in another ocean basin does this, I will therefore assume it is not that different in this ocean basin. I will use that as my best approach for management until I have better information.

251. "Notwithstanding the status listings, would you not say that there are sea turtle populations in the world which are quite healthy and which have benefitted from long-term conservation programmes started some 30 years ago?" [question 9 by Malaysia] Definitely, any conservation programmes, especially if they started 30 years ago, would have benefitted sea turtles. What worries me is "quite healthy". I am not sure what "quite healthy" means. As a global phenomenon we have seen that there have been declines of sea turtles populations around the world, that is why they are listed in IUCN and CITES as endangered species. This is not a trivial observation, it is a global observation. If a few years ago someone had asked me where are the healthiest populations of sea turtles, I would have turned to my colleagues in Australia and said, they have them in Raine Island. But now I am terribly depressed to know that even those populations are declining. Colin Limpus,

whom you have heard cited numerous times during these proceedings, has shown that populations in Australia which were enormous, are now in decline. The reason they are in decline evidently is that when they migrate out of Australia into other waters of neighbouring countries, they are subjected to very high mortality, in some cases a direct mortality. So I would prefer to put, instead of "quite healthy", "at a lesser degree of risk". I am not comfortable with "quite healthy".

252. "Which species are most vulnerable to trawling?" [Question 10 by Malaysia] Certainly, the information which is available from the US shows very clearly that loggerhead and Kemp's ridley are highly susceptible to trawling. Those are the species which are most abundant in those waters. Where the behaviour of a turtle means that it will share time in the water in areas where shrimp occur or shrimp trawlers occur, it makes that turtle obviously subject to being caught in trawlers. My information is that in Surinam (where I have never worked and I must be clear here), there seems to be some confusion at some point. I am not responding to this information with my own personal experience. I am responding as a scientist reviewing information that I can gather. I have not worked in Surinam, the information I have from reading this scientific information is that indeed green turtles and olive ridley's are subject to capture, and at some degree of importance in Surinam. We do not have good data from Gahirmatha. Colleagues who work on that beach, and this number has been bantered around quite a bit, have shown that there is a large number of turtles which are stranded in Gahirmatha. There is some question as to whether that is in gill nets or trawlers or some other type of fishing activity. No one has done a study, those data don't exist. However, the simplest explanation that I see and my colleagues, for example, colleagues from the Wildlife Institute of India, see that a significant number of those animals are being drowned in shrimp trawlers. We have no data, no study has been done and that takes me back to the precautionary approach. To say that I don't know cannot mean the problem does not exist. We have to be very careful, not to do that because that will simply make it more difficult to solve the problem. I would say that our lack of information makes it very difficult to know whether outside of areas where there have been long-term studies, whether other species are highly susceptible. I would certainly say that in Surinam, other species other than loggerhead and Kemp's ridley are susceptible from the data I have read, and the indications that have come from Orissa indicate that olive ridley is heavily affected there. Along the Pacific Coast of Central America, there are good data that olive ridleys are captured in very large numbers; the estimates for just the country of Costa Rica were 20,000 turtles a year captured in shrimp trawlers. In other countries north of Costa Rica there is less information and less study, but the numbers appear to be very significant. I am confused by a lack of information, but the snippets, the pieces of information I see from the people who work in Sabah make me very worried that there seems to be some kind of interaction between green turtles and trawling in the south. The reason I say this is indeed in this submission by Malaysia, the last page, which is a study done by Mohammed Suliansa. He ends by saying that there is a need for study of accidental capture of turtles in trawl nets and that there is a need to educate the trawl operators. My guess, I would need to speak to him, my guess is that he is concerned, and the reason that he is concerned, that he has manifested here, is that there is a problem. I remember in one of the submissions, that there are data which show that there are strandings of turtles when trawling begins in Sabah. The same phenomenon has been well documented in the US, in Texas and Louisiana especially, that when trawling begins in Sabah, strandings begin. The number of turtles which are documented is very small, and a large number of the turtles which were documented, there was a large number of those turtles for which the cause of drowning was not known. I don't have the report in front of me but, as I recall, a very significant percentage of the drownings, of the sources of mortality that could be determined, were from trawling and those were green turtles. So I am very concerned that we don't know, but certainly the people who are working in Sabah seem to be indicating that there is a very high potential for a problem. So, again my long elaborated comment which hasn't provided you with a dogmatic yes or no, again I am manifesting my ignorance. We don't have enough information but I would say, yes, other species are subject and we have to be careful. The lack of information cannot be used to prove that there is a lack

of a phenomenon. If we can do studies, if someone can do a study and show that so much effort of trawling has produced so many turtles, then we can make a comparison. Without that information we are blind. I think I'll finish here.

253. I am going now to the questions provided last night. "Are other sea turtles found in each of the complainants waters that the members of population are not yet showing signs of recovery?" [question 1 by the United States] The issue of recovery has been deliberated. Again we must be very careful, we are dealing with complex animals that have these long periods of time to mature, which have long life cycles. To understand them we need long-term data. A short-term study will not give us the information we need. There are two populations which in voluminous proceedings have been discussed as having recovered and I am told to leave them aside, well at least the Sabah population aside. Under the instructions here that would leave me with Gahirmatha. I don't know what's happening at Gahirmatha. Obviously large numbers of turtles are nesting at Gahirmatha, at Devi and Rushikula. There are three mass nesting areas in Orissa that have been discovered so far. One has to be very careful, I address this in my comments, with numbers, especially from mass nesting areas. I mentioned previously the difficulty that the Australian biologists have in counting green turtles on Raine Island. With olive ridleys in mass nesting situations, this is even worse. There can be tens of thousands of animals on a beach in a single night. It is physically impossible to have a good count. I really sincerely wish that everyone here could see this. It is a phenomenon which makes you understand why sea turtle biologists are as crazy as we are. It is something that renews your faith in the world to see this, it is phenomenal.

254. In order to estimate what's happening with the population, you need long-term data. If you are going to use numbers those numbers have to be something that you have to have confidence in. If you are estimating numbers, you need to have what are called confidence intervals around those numbers. I can count everyone in this room right now and produce what is called an exact estimate. But if there were so many people in the room that I could not count them and I had to do a statistical procedure of counting, a sample of them, I would have to be careful to be scientifically rigorous. I would have to have this done in such a way that there were confidence intervals around that number. This has been a major source of difficulty with the mass nesting populations. Statistics for these numbers are very sloppy and there have been attempts now on a beach in Costa Rica, called Nancite, to try different ways of estimating mass nesting populations. One is to use a transect down the beach and to count over a period of days at a fixed interval, the numbers of turtles that are in the transect. Another is to use what is called quadrat (a square area on the beach) and count the number of turtles in that quadrat. Then you have enough transects and enough quadrats to produce an average and then a variation around that average which gives you a confidence interval. Unfortunately, these two methods don't always give the same estimates and we are now a little bit confused about what we should do, because on some beaches people have been using transects and on other beaches people have been using quadrats and we are not sure how to compare these data. My colleagues at the Wildlife Institute of India are very concerned about getting counts from Gahirmatha which have confidence intervals. I spoke with some length with Bivash Pandav who is the graduate student who is doing this study. We have discussed some of the pros and cons about the widths and lengths of transects and I am confident that he is a remarkably dedicated man and I am sure he will be getting very good data from Gahirmatha which will provide confidence intervals. We need long-term data by the same institution on beaches. Gahirmatha was monitored by the Forest Department of Orissa, the Central Marine Fisheries Institute for some years, by other institutions, and every institution will have its own way of counting. So it is very difficult to know just what's happened at Gahirmatha. I would be pessimistic to say that I don't want that population to be in recovery, or to be growing or to be at least stable, but I don't know that, I can't say that because I don't understand enough about the way the numbers have been derived and I don't see confidence intervals around those estimates. So I would be careful about saying anything about Gahirmatha at the moment. Sorry for such a long talk, but they are such complex animals. Yes, "if they suffer mortality ..." [question 1 by the United States]

clearly, that is what we have been trying to explain. Any source of mortality, especially directed at the animals which have been able to survive this long period of maturation, is very very costly for the population. I'm not saying that eggs are not important, I'm simply saying that those animals that have managed to have the good luck or good sense to do the right things for 10 or 20 years, those are now very valuable to the population. If we loose them, it is a very costly loss for maintaining the population.

255. This magic number of 5,000 turtles stranding in Gahirmatha [question 2 by the United States]. Firstly, let's be very clear that 5,000 is a number of strandings, it's not mortality. We don't know how many died but certainly many, many more than 5,000. How many more I can't say, 10,000, 15,000, I can't say. But certainly if 5,000 were counted dead on the beach, the number that died would be many many more. We need to know how long they float, we need to know what the currents were, we need to know what the winds were. The only people that, as far as I know, have looked at this in a systematic way are researchers from South Carolina and I have provided a synopsis of that in my comments to show some of the problems of trying to interpret stranding data in terms of mortality. So, let's be clear that this is not mortality, this is stranding. I am worried by that number. I realize that large numbers of turtles nest at Gahirmatha, but a continual mortality of in excess of 5,000 animals (some number we don't know) worries me and I would not be comfortable to call it minor or relatively minor.

256. The third question [by the United States], "does existence of all these threats make it more or less important to prevent sea turtles mortality in shrimp trawlers?" Evidently, I haven't been clear, I would have thought that my comments had made it clear that the more sources of mortality we have, the more risks these animals are under, the more we have to use every possible means to reduce mortality. Liew in his comments, at some point said that it's necessary to reduce all sources of mortality. Again we don't know enough. If I could sit here very cooly and say, "Gentlemen, this population is this big, the sources of mortality are here, its rates of recruitment are this, this source of mortality is therefore unimportant and we can ignore it", if I could do that, it would be a different sort of situation, but I cannot. I don't have that information, I don't believe anyone does. The fourth question [by the United States], "do the experts agree that TEDs when properly installed and used reduce the mortality of sea turtles?" I thought that was clear, yes. I thought as far I understand there is a consensus that if they're installed and used properly they reduce mortality. I have tried to address this also in the Annex. [Annex 1 to the report] A TED is not a piece of magic, it's simply, a BED "a bycatch excluder device". Now fisheries biologists don't use that [term] so much, they use more BRD which is a bycatch reduction device, but it is simply a way of removing some part of what is caught in the net from the net. In the fisheries biology discussions you will often see discussions of the need for fisheries techniques to be more selective. More selective means, I'm going to target this species because I want to catch it, because I want to eat it, because I want to sell it. Therefore everything else that could be affected by my fishing activities has to be left out of it. A BED is a way of making a trawl more selective, perhaps less unselective. A TED is a modified BED, a modified BRD, which is designed to remove sea turtles from a trawl net. It's very simple, it's a sort of filter, I'm sure you have seen drawings of them, the grid TED, the one you developed in Thailand, the Thai Turtle Free Device or the Georgia Jumper or the Super Shooter or the AusTED, simply acts as a filter. It permits small things, like prawns and fish, to pass through and large things like a turtle can't pass through and is pushed up. If it is a top-shooter it goes up through the top; if it is a bottom-shooter, it goes through the bottom. The concept of a TED is very simple. There are problems, people need to learn how to use them as with any kind of equipment. There was a question in here, does the level of education affect the way a fisherman works. Fishermen may not have a formal education; they may not have doctorates, but fishermen are people who have a tremendous amount of practical experience, if they are professional fisherman. They are people who, I think, most of us here respect greatly when we work with them. So, I don't think formal education is a matter of concern. These are people who

learn by experience. If the fisherman is shown how the instrument works with a gear technician and given time to work with it, I don't see any reason why he can't learn how to use it. He has to learn how to use it, definitely, but he also has to learn to use his winches, he has to learn how to use all the instruments he uses on his boat. It's part of the equipment.

257. "If all the world's shrimp trawlers use TEDs would this contribute to the reduction to the threat to the sea turtles ...?" [question 5 by the United States] Again, I would have thought that at least my own comments have made this clear. I would like to explain perhaps why I have troubled you all with yet more papers, with an Annex on bycatch. To me this issue is a bycatch issue. When we are talking about turtles caught in shrimp trawls, we are talking about a bycatch problem. They are there because they are bycatch. Therefore, the whole issue of bycatch is relevant, it fits within that complex of problems. As I have tried to indicate in my written comments, a TED is a BED, it's a modified bycatch excluder device which is designed to remove turtles. Depending on the design of the TED, you can also remove other unwanted elements from the trawl nets, and that can include, depending on the way you design your TED, that can include other species of animals which are being negatively impacted by shrimp trawling. My strategy as a conservation biologist now takes me outside of biology and technical aspects into the realm of dealing with people and indeed impacting political decisions. My vision as a conservation biologist is that TEDs could be an important first step in showing fishermen that they have to be more selective. So, I would take question 5 [by the United States] and say that this focus is too narrow for me. I would say that TEDs indeed, not only are important for reducing catch of sea turtles, but for dealing with this very, very grave problem we have with bycatch and showing the way to open up methods for getting fishermen to be more selective. Bottom trawls are notoriously damaging to the environment, the history of bottom trawling in tropical countries is a very sad history. I have mentioned in the Annex that there are civil movements, there are organizations of fishermen from the Third World, from developing countries who are calling for a ban on bottom trawlers. This is a very, very serious situation. These people feel that their lives have been impacted negatively by bottom trawling; their gear has been destroyed, their sources of livelihood have been destroyed by bottom trawling. I know that fisheries officers in many countries, not publicly but among themselves, would be much happier to get rid of bottom trawling. It's not going to happen quickly, if it happens at all, but certainly one way to move towards making this very damaging fishing technique less damaging is to start implementing more selective ways of fishing. One of those is to get TEDs in the nets and show the fishermen that they can't continue this way, you have got to be more selective. I was talking with Liew yesterday, I am in total agreement with him. They are fishing with nets that are so closed, the mesh sizes are so closed that virtually nothing gets through. I am surprised they can even advance in the water, it is like they have a tube which is almost closed. They are catching all the larvae, this can't go on indefinitely. We have seen that FAO and I believe, Thai fisheries experts, have estimated that the demersal stocks in the Gulf of Thailand are now 10 per cent of what they were when trawling began 30 years ago. We are in a desperate situation and this is much bigger than sea turtles, we are seeing the tip of the iceberg. I am very clear, this is the tip of the iceberg. If we can deal with sea turtles in such a way that it will give us momentum to solve these other bycatch problems, I think this will be a major contribution to fisheries management. The sixth question [by the United States]: will prizes be given out?

Mr. Chairman

258. Only if you get to the end!

Dr. Frazier

259. "Dr. Poiner and Mr. Guinea mentioned time and area closures are helpful ..." [question 6 by the United States] Yes, that's definitely true; they are helpful. Do we have enough knowledge to identify potential "hot spots." Again, I sincerely believe that the way Australians manage their

fisheries is something we should all learn from. Ian Poiner and I had a discussion on record yesterday; he clarified that effort is essential, that simply limited entry doesn't have all the answers and later on we discussed this further. I am still convinced that the Australians are way ahead of the rest of us, they have, Ian was explaining to me, 120 vessels in the northern prawn trawling area and 1,100 to 1,200 licences in the eastern fishery, not all of which are fishing. If we could only deal with such a small number of vessels, it would be much easier to manage. I don't believe any of us here, any of the countries assembled here, has a fishing management programme as well set up as that. We are dealing with thousands of vessels. I will let him explain to you what they are doing, it's marvellous. They are going to be able to monitor where the vessels are, on real time, to be able to actually communicate with them. They can do magnificent things in that fishery. We were talking here about, I believe, another situation, other fisheries which are extremely large. I don't see how we can possibly pretend to enforce time and area closures without tremendous amounts of investment in vessels which will be out there looking for this. The indications I see in FAO documents, written by or about, for example, some of the Malaysian fisheries officers, lead me to believe that they are very concerned with area closures, with the zoning. There is one report by Hilmi, which I mentioned in the Annex here, there is another report from Ali, the way they are expressed I see concern that they are not confident that they are getting exclusion from that 5 kilometres. At one point it says, I believe, fishing will go on unless enforcement vessels are seen: why would you stop fishing if an enforcement came along, unless you were doing something that was against the law. If you were in the right place and an enforcement vessels comes along, what difference should it make to you. We know classically that area closures in fisheries with large numbers of vessels are very, very difficult. I know that Thailand also has excellent laws. The laws in both Malaysia and Thailand, I believe are very well thought out to provide area closures, zoning. I am not convinced that the trawlers are respecting this. Everything I read makes me think the opposite. I see that there is concern indeed in some of the documentation, which I believe was provided in Thailand. There is a discussion of why are the trawlers coming into the coastal areas. It's normal, it's human nature as Daniel Pauly has pointed out - this man is one of deans of fisheries biology in South East Asia.

260. In general shrimp are coastal species, shrimp and prawns occur along the coast. Ian Poiner was explaining to me yesterday, in Australia, they target them, he can explain it much better than I can. They do terrestrial phenomena for nutrients, nutrients come from terrestrial phenomena, nutrients coming down rivers in catchment areas. This means that they will be in coastal areas, where those nutrients are most concentrated. Certain sorts of habitats such as sea grass and types of bottom, will not be long distances from the coast in general. That means that if you want to catch prawns you have to come close. When you come close, you come inside the zones where they have been to told to stay out. When you do that you cause conflicts with a small-scale coastal fisherman. The documentation of conflicts, of civil strife, caused by trawling in the tropics especially in South East Asia, there are libraries full of this. There are grave, grave social problems caused by trawling, by trawlers coming inside these coastal areas. The laws are very well thought out, but I don't see the trawlers are respecting them. There is such a pressure to get prawns from the coastal area and they are coming inside. I cannot provide you with studies, I don't believe such studies exist. What I see in the FAO documentation and in the reports of the experts from these different countries make me very concerned that they are also very worried about infringements in coastal areas.

261. The time closures, unless we are talking about long periods of time, will often produce what is called "pulse fishing": I will allow you to fish this period and that period and then this period you cannot fish. By human nature the most likely thing is the effort which Ian Poiner talked about yesterday. The effort will increase just before the closure, so that I can catch as much as possible before they stop me and the moment they let me start again the effort will be very, very intense. This may mean then that all the animals that were not impacted during the time closure are subjected to a very, very intense effort just before and just after. So, time closure has to be looked at with great care

if it's really going to work, simply legislating a time closure and pretending it's working is not necessarily going to work.

262. "Do we have enough knowledge to identify potential hot spots?" [Question 6 by the United States] No, we don't. This seventh question has been dealt with. Then I will finish with TEDs which will take 6 to 8 years [to implement]. Australia has been working through voluntary implementation which I have tried to explain in my written submission, which I firmly believe is the best way to go: to work with the fisherman, in terms of community based conservation. However, where you have fisheries which are extremely large and in my opinion outside of normal control, where the fisheries department is unable to develop this sort of contact where you have a limited fishery, it's a tremendous problem to develop rapport with the fisherman and get voluntary compliance. I would much prefer voluntary compliance, there is no question in my mind at all about that. But if you can't do it, what will we do? Will we just wait? How long will we wait? Will we wait until resources are so diminished that there is nothing left to save? I know that Dr. Silas from the Cochin Central Marine Fisheries Research Institute, years ago, in 1983, proposed adopting TEDs at least in Orissa. Dr. Silas is, he is no longer Director of the Institute, but he is a very dynamic person with tremendous vision. Other fisheries officers, other people concerned with conservation of marine resources followed this up with other suggestions. It's not easy, I know this, but nothing has happened so far. How long can we wait? How much destruction of these resources on which many coastal peoples depend, can we tolerate? Something has to be done to tell these trawlers "you cannot continue like this, you have got to be more selective, you've got to take care of these resources, they are not your resources." These resources, if we are talking about the trawling, are national resources, they do not belong to the trawling community. They belong to the nation and I am deeply concerned - this is why I have gone into great detail with the social aspects - that other people who have a right to these resources have also access. In South East Asia there are large communities of people who for generations used types of fishing which are selective. They have done this for God knows how long, and now those people have been marginalised by a technology ... [end of tape] ... which is very, very destructive. I believe trawling in this way is socially unjust and I am very concerned about it. I would say there is great reason to make trawling as selective as possible, as fast as possible. I would prefer that it be voluntary and if we can't do that then, something has to be done, such as in Thailand where it was legislated and quickly done in a matter of months.

Chairman

263. Thank you very much, Dr. Frazier. Dr. Guinea?

Mr. Guinea

264. Thank you Mr. Chairman. In reply to the questions posed by Malaysia, those questions which were directed to Dr. Eckert have been adequately explained by him or answered by him. I do not wish to comment on the first four questions. The questions directed to all the experts, "in your expert opinion, would trade prohibition on the import of shrimp to the US by itself save sea turtles from shrimp trawlers and extinction?" [question 1 by Malaysia] I have addressed this before in my opening remarks and also in my written submission. As I was going through the submissions by the various parties I was looking for some index or some measure of reduction of fishing effort resulting from the embargo. Some of the documents are still fairly recent but the figures indicated that the exports from the affected countries to the USA decreased. This simply meant that the product going into America was reduced. I was looking for some measure to say that the product that was not allowed into America, was being dumped or was the trawl fishery suffering; were there boats remaining in port because they could not comply with the US embargo? Nowhere in the document was there any evidence to suggest that the fishing fleet had been reduced, that there were hardships being accounted on the trawl fisheries and in discussions at other meetings it was indicated that the product was making its way to other markets. This was expressed as a concern in my submission by some of the fishery officers in Australia. So if there is no reduction in fishing effort, then the same number of vessels are going to sea for the same number of days, towing the same number of nets and, should they be encountering turtles, they will be encountering the same number of turtles and regardless of where the product is going. In this regard I see the US are saying "we do not want to eat a product that has not been caught in a particular way". Now that does not affect the number of turtles that are surviving, it is a preference for a market or for a way a product is being prepared. So if you are looking for some measure of the success of an embargo, you will be looking for a thing such as positive outcome in terms of the numbers of sea turtles that are surviving on the trawling grounds. I have yet to see numbers to demonstrate that after some years of TEDs being used in the Gulf of Mexico, Caribbean sea fisheries, that the turtle numbers have actually increased on those fields. We have figures relating to a decrease in the number of turtles washing ashore, that is referred to as a "stranding", that you would be looking for some positive measure to say "yes, if 5,000 turtles were not killed this year then the population of that trawl field should have increased by at least 5,000". If the TEDs have been installed for 5 years then it is 5 times 5 and we are looking at 25,000 turtles increasing in a population. That sort of data just has not been presented - that is a concern.

265. Also looking at the embargo, there is no indication of milestones or checkpoints as to how the success of the embargo was likely to be planned. There seems to be an adoption that once a TED is installed then the turtles will be saved from extinction. I think that if you are going to put some form of an embargo in place you will be keeping regular checks of what is happening not only with your own population on the feeding grounds but also what is happening on the population of sea turtles in the affected countries. That does not seem to be happening either. There may be a need to develop surrogate measures of sea turtle survivorship or sea turtle mortality. This may be best directed towards some sort of measure of fishing effort presented in a standard format in either head rope lengths, number of boats or something in that nature, and there seems to be a mixture of measures by which effort is mentioned. In some countries we simply have a measure of the number of vessels that are involved with a fishery - whether that is 2,000 vessels or 3,000 vessels - but that still does not give an indication of how long each tow is, how many days they are at sea and what is their likely capture of sea turtles. There is a general lack of information provided in the submissions in this regard. The other point that I was looking for was did shrimp prices increase in the USA as a result of the embargo? What incentives are there for the affected countries to coerce their fleets to bring about the implementation of TEDs - indicating that "yes, you can get more money for your product if you are using a TED". In fact, the information provided with the submissions indicated that the costs of shrimps actually decreased after the implementation of the embargo. In fact, it decreased by about 9

dollars to 8 dollars or something in that order per kilo. So those figures indicate that the market was not maintained; it was not a profitable market awaiting countries that are implementing the use of TEDs. There are also other questions. I have addressed the fact that other markets were found for the shrimp products. It has also been suggested, and the US has challenged this, that some shrimp or shrimp products could be transshipped through third party countries. Now, whether this does or does not occur, it could surely be a valid case for environmentally labelling products as to the country of origin and method of capture, etc. I shall just state the point again that TEDs or turtle-excluded devices are just one of the options that should be or could be imposed in the responsible management of a fishery. I think that might suffice for question 5 [by Malaysia].

266. "What is the acceptable recognized method of determining the population size of breeding units of sea turtles especially in the assessment of population trends?" [question 2 by Malaysia] From the literature there appears to be no case of a sea turtle nesting in one country and then nesting in another country. We talk about migrating to a nesting beach and that nesting beach has a geographic location and then that geographic location becomes the centre of the breeding unit. That may in fact be one beach, it may be a number of islands, it may be a geographic location covering several hundred square kilometres. This is actually fundamental to all the other aspects of sea turtle biology. We talk about using mitochondrial DNA to look at philopatry - or the return of individuals to their nesting beaches. If a turtle is nesting in one country and then moves to another country and then moves to another country to nest, if those countries are at a distance, then all the mitochondrial DNA work should be thrown out the window. The basis of the mitochondrial DNA is that there is only migration between breeding units at a rate of less than two females per generation and that means that in the lifespan of a sea turtle, which may be some decades, no more than two females will move from one breeding unit to another breeding unit. That is fundamental. So the breeding units become the focus of your conservation measures. If one breeding unit is wiped out, through any number of reasons, it will not be replenished by neighbouring breeding units because the sea turtles exhibit a strong returning to a geographic locality for breeding. Therefore by assessing the number of females on a breeding ground you can assess the status of your breeding population. All of the life tablework that has been produced, the growth models are in fact based on female sea turtles. So when we talk the magic number of 584, we are talking about 584 females. We do not talk about the number of males. Therefore we use a philopatrical breeding area as the unit for assessing sea turtle populations - either the relevant numbers, the relative importance, the changes from year to year and also seasonal declines over time or in fact increase over time.

267. Question 7 [by Malaysia], I have also raised this point of stocks and breeding units. I prefer not to talk about stocks, I prefer to talk about breeding units. Stocks tend to be a very value-loaded concept where historically in fisheries they tend to be able to determine all the parameters of the stock. With a breeding unit, the concept, on the other hand looks at the means of assessing the numbers of nesting females. And you can actually live with the situation of not knowing where all the individuals are at any one time of that breeding unit, as long as there is an assessable number that is returning annually or over a period of time to the breeding area. With the concept of stocks regularly on a feeding ground, it is likely that you will have more than one breeding unit of sea turtles present and it is important to address the composition of the feeding ground as regards to the breeding unit composition. As an example, if there are two breeding units on a feeding ground, at the rookery, one of those breeding units might be suffering very heavy egg harvesting, natural mortality or commercial harvesting of their products. The other breeding unit may not suffer those consequences on the nesting beaches. In order to prioritize your conservation activities, if you can identify that, not only is a population being negatively impacted on a feeding ground but is also suffering heavy mortality on the rookery, then that breeding unit can be ranked as being more worthy of conservation effort than a breeding unit that may be suffering some mortality on the feeding ground, but the rookeries and nesting areas are still intact. In terms of being able to prioritize your research activities, your conservation activities, you can then nominate very clearly that you are going to address a

particular aspect of one breeding unit of sea turtle and you are going to address particular points regarding its life cycle and its conservation. This also brings about the fact that, as far as funding organizations can go and also managers and funding agencies, you can produce stronger and more focused arguments to protect, as a matter of priority, selective breeding units. This could be a case for funding organizations to identify projects, give them a better chance of success and also it would bring the researchers into more accountability for actually producing what they set out to do. I think this business of accountability, of research funds and the conservation dollar is very important. I think I shall leave question 7 at that, thank you.

268. Now in question 8 [by Malaysia], "when studies on any particular sea turtle population are made, would the results apply to the population being studied or would you generalize the data for all sea turtles irrespective of the species or where they occur?" There are fundamental dangers in generalizing. There are fundamental dangers just as there are in generalizing about countries. There is fundamental dangers in generalizing not only about what a species does, not only about its growth rate, not only about where it lives, but not only where it occurs on the feeding grounds. There is also dangers in generalizing about fisheries because a generalization can lead people to think a fishery the world over is the same. Therefore the way a net is operated in Australia is similar to the way a net is operated in the USA or regions where nets are operated. So there is a danger and I find this in the report saying "shrimp trawling in the USA versus shrimp trawling in Malaysia". I am not aware in either country whether the shrimp trawling is exclusive of sea grass beds or whether shrimp trawling is conducted up to the shoreline, or whether shrimp trawling is conducted at night or whether shrimp trawling is conducted in all seasons of the year. We have this generalization that shrimp trawling per se, regardless of any other management implication or procedure used by the fishers themselves, is then transferred immediately to another country. I think this is a danger in itself of generalizing in trawl fisheries. Because sea turtles and trawls are the focus of this talk, I think that it is a justification for my wandering into a fisheries area. So just to reiterate, it is very important to exercise caution in interpretation of sea turtle data and also fisheries data.

269. Question 9 [by Malaysia], "notwithstanding the status listed of sea turtles provided in the IUCN etc. would you not say there are sea turtle populations in the world which are quite healthy and which benefit from long-term conservation programmes that started some 30 years ago?" I think all sea turtles benefit from conservation programmes which started 30 years ago. There is a few milestones in these conservation programmes where fundamental research, such as the longevity of different tags that have been applied to sea turtles, the effectiveness of different tags. It was only a few decades ago where we were talking about particular species of sea turtles nesting only once in their life. The reason for those misconceptions was the fact the tags which were applied to those turtles fell off in about 10 years and so therefore we had so few tag recoveries, we were led to the idea that they nest during only one season and there were many options built on those assumptions. Now over the last 20 years, having changed from Monel metal to Inconel to Titanium we realize now that the turtle tags can remain far longer, possibly as long as the turtle. So now the whole focus of these early management options have been changed. That brings about an increase in benefit to all sea turtles - not just those turtles that were tagged on the Great Barrier Reef or not just those turtles that were tagged in Southern USA. Sea turtle researchers in other countries do not have to follow the same path; they do not have to make the same mistakes over and over again in doing the fundamental research. If you are looking for areas that were quite healthy, there is good documentation from South Africa where species numbers have increased. I should also point out that in a number of countries, Australia included, sea turtles were not actually protected until about the 1960s and prior to that there were active turtle soup factories. Turtles were harvested and turned into soup and exported to whoever wanted to eat turtle soup. It was only in the 1960s that conservation efforts came in. So that is still less than one generation time for a green turtle which was the target of the turtle soup factories. In that regard, having removed the commercialization from sea turtles of Australia and

remove the cash value of the turtle, those turtles have enjoyed a degree of protection for the last 30 years. There has been a move for cash value of sea turtles in neighbouring countries, from where the Australian breeding units move, and this is a cause of concern. There has been a general realization that in some areas sea turtles are negatively impacted by prawn trawlers or shrimp trawlers. The overall conservation measures provided in Australia are trying to build a secure foundation for sea turtle biology - for sea turtle conservation. Realizing the time frame, then we are hopeful that in years to come we have good news of sea turtle numbers in scientific literature rather than bad news of decreasing numbers and the like.

270. Question 10 [by Malaysia] talks about loggerheads being the most dominant species followed by Kemp's ridleys. In response to that question I would like to know whether the composition of the catch in shrimp trawls in the USA is a true reflection of the distribution and abundance of sea turtles on the feeding grounds in the Gulf of Mexico and the Caribbean sea. It would appear from the Australian studies that not all sea turtles are impacted to the same extent. Not all sea turtles suffer the same mortality. Some species seem to be more resilient to being dragged in a prawn trawler. Others, by their particular behaviours, may be more susceptible to capture. It has been suggested in some of the literature that green turtles, being quicker, can outswim the approaching trawler net. Loggerhead sea turtles, being less agile, less inclined to swim, are more prone to being captured in trawl nets. So there are a few questions that have to be sorted out. One is whether you have a true sample of your feeding population being presented in the shrimp trawl bycatch or whether you have particular species which through the course of their nature or energetics or may be even feeding biology are more prone to being caught in a shrimp trawl. In that regard you may find that loggerhead sea turtles may be far more prone to capture because they are more reluctant to swim out of the way of trawlers. That is a supposition and you have to do a lot of work with trawl and experiment with loggerheads in a trawl net environment. However, there has been some suggestion that this is in fact the case.

271. If I could just turn to the questions posed by the United States - the first question refers to the status in the complainant's country, in the complainant's waters. There are members of populations which are not yet showing signs of recovery. "If such sea turtles suffer incidental mortality in shrimp trawl nets would this not contribute to the endangerment of sea turtles?" [Question 1 by the United States] As I just mentioned in my last response, some of the sea turtles are more prone to being caught in shrimp trawls and other sea turtles seem to be less prone to capture in shrimp trawls. Seeing that on the Panel of Experts we have Mr. Liew,who is far more familiar with Malaysia than I am, I would like to leave some of the aspects of this answer to Mr. Liew. I would also mention that some of the population in Malaysia, possibly the leatherbacks in Terengganu, may still not be recovering; but then, they may not be affected by shrimp trawling either. So again, I reiterate the problem of generalizations.

272. In Question 2 [by the United States], which was directed to me, I produced in my response a calculation, to which I would like to thank the United States for allowing me to expand on this aspect of my submission. The reproductive value figures that I mentioned yesterday are a mathematical abstraction, and are in fact modelling which have been used to indicate the relative worth of an adult female loggerhead in the south east United States of America. This figure has a great deal of plasticity, as indicated by the much lower values of between 200 and 400 in Australian populations of the same species. This value of 584 is the most widely quoted value in submissions and also in the masterly works provided by the National Academy of Sciences in the Decline of Sea Turtles. Due to the lack of reproductive values for other species, the figure of 584 has been used as an implement to argue the worth of adult sea turtles in other species. However, as an instrument, it is like a two-edge sword that can be used to predict the survivorship of eggs to adults and the subsequent recruitment. It is in this context that I have used it to illustrate the possible recruitment to the Gahirmatha olive ridley population. A nesting population estimated to be 500,000 females would produce approximately 50 million eggs and this figure comes actually from the submissions. In a season, using Crouse's

figures for loggerheads, the recruitment would be possibly 85,000 female adults. A mortality of 5,000 female adults represents less than 1 per cent of the estimated nesting population and should those 5,000 die before reproducing, it would be less than 6 per cent of the year's new recruits. Should the reproductive value of Gahirmatha olive ridleys be 200, as it is for some of the breeding units of the Australian loggerheads, then the recruitment would be in the order of 250,000 individuals in one generation's time. So sea turtle reproductive strategies are an exercise in numbers. To the casual observer the loss of 5,000 individuals would be a reason for concern but when the nesting population is estimated to be in the order of 600,000 animals, then this loss is relatively minor. The concern should be not for the absolute number, but rather the proportion of a breeding unit that is adversely affected. Within the various submissions I found figures of one million turtle eggs being taken to market or 400,000 eggs lost to natural causes. This should be viewed in relation to the total number of eggs deposited by the breeding unit in one generation, which may be for them some decades. Although these numbers are large, sea turtle biology is all about a numbers game. You have to look at the egg production in a generation by a breeding unit to ascertain whether that is an effective or substantial number or whether that is relatively minor.

273. Question 3 [by the United States]: "all the experts have noticed various causes of sea turtle mortality including mortality on the beaches and due to incidental mortality in shrimping and fishing operations. Does the existence of all these threats to sea turtles make it more important or less important to prevent sea turtle mortality in shrimp trawlers?" If you use the paradigm of a breeding unit then you have to address this on a case-by-case basis rather than a gross generalization. It is the case-by-case basis that is important. Only on this case-by-case basis can you actually achieve something. If you take on conservation of sea turtles of the world as your prime objective, then you are unlikely to succeed. However, if everybody is working on a case-by-case basis, the total of the conservation effort may well in fact result in the conservation of the sea turtles of the world. So, in answer to question 3, you have to look at this on a case-by-case basis.

274. In question 4 [by the United States]: "do the experts agree that TEDs when probably installed and used reduce mortality of sea turtles in shrimp trawl nets?" I would think that there needs to be more information provided with this question. We are talking about TEDs properly installed. I would go further to say, if the TED is properly designed for that fishery and if the TED is properly installed and properly used, then it will reduce the mortality of a trawl fishery. To explain this: if a country or a fleet bought a TED off the shelf from a producer and used that TED blindly, thinking that "yes, this will be the answer to all their problems", then they are unlikely to be successful. If they are going to look at the use of a TED, the TED should be designed for those fishing areas and this may in fact involve several designs operating within a country. Selected areas may be looking at a TED specifically designed for the sea turtle population that is likely to be encountered in that trawl field. This may involve narrow-grated TEDs. It may involve larger TEDs. It would depend on the sea turtles that are present on that feeding ground and the level of trawl activity. Again, the size of the sea turtles is also important. Also the species of sea turtles. In fact some work has gone into the AusTED, in recognition of the fact that the flatback sea turtles are one of the most commonly caught sea turtles in the Australian trawl fishery. There are in fact no data available for how flatback sea turtles behave in trawl nets or how they respond to TEDs. Therefore, there is an argument for countries to develop a TED for their trawl fishery based on the species of sea turtles that are present.

275. There appears to be no data available for olive ridley sea turtles in TEDs from the USA. Olive ridley sea turtles are a component of the feeding grounds in the countries concerned. So I shall go further to say that a TED, if it was properly designed and installed and used in a proper manner then it will go some way to reducing sea turtle mortality. If the United States figures are still a decrease of 40 per cent in strandings by the use of their TEDs which were properly used, properly designed and in their fishery, you could not say that they were going to have a complete reduction of

sea turtle mortality. It will go some way to reducing the sea turtle mortality in the trawl fishery or the shrimp trawl fishery.

276. Question 5 [by the United States]: "if all the world's shrimp trawling fleets used TEDs would this contribute to the reduction to the threat of sea turtles?" The answer to that, we need to look at what is meant by the world's shrimp trawling fleets. Is it the desire for the United States to comment on the temperate water shrimp trawler fleets or should we restrict their answers to the tropical water shrimp trawl fleets? Of course, by exclusion the temperate water shrimp trawl fleet tend to have little or no impact or implied impact with sea turtles. So the question should be whether the use of TEDs would contribute to sea turtle conservation and I think my last answer would indicate that properly designed TEDs, properly installed TEDs would go some way to reducing sea turtle mortality. Until we get better data from the United States as to the effectiveness of their TEDs, I would be hesitant to say that they will go all the way to achieving their 97 per cent reduction in sea turtle strandings.

277. Question 6 [by the United States]: I shall leave the full discourse of time and area closures to Dr. Poiner, if I may. But I will make some comments. "Could the experts comment on this and in particular address whether sea turtle mortality could also occur in areas during times where shrimp trawling is not banned?" Now I have some confusion over this. Sea turtle mortality occurs throughout the sea turtles' life; whether trawls are present or not. It is my experience dealing with stranded sea turtles that when we encounter a dead turtle we tend to look for someone to blame, rather than for something to blame. I have encountered this in parts of Timor Sea where, during particular spring tides, sea turtles that are slow at moving off the beaches are caught on the reef flat and succumb to the heat during the day. Those turtles may then wash up on beaches in the area. Part of my work then is trying to assess whether this sea turtle died of natural causes, whether it be through a misadventure of tardy nest preparation and being caught by the heat of the day - succumbed to the heat during the low tide. So we have developed a stranding or a means of assessing strandings as to whether this a likely impact of a natural cause or whether this has been an impact of subsistence fishermen in the area who have moved in and taken a turtle or has it succumbed to fishing operations in the area. So I think when we are looking at sea turtle mortality we have to improve our intelligence as to what was the nature of the mortality. There are a few things that can be used to ascertain whether this animal drowned, was dropped onto a sorting deck, caught in a gill net, has been through a drum winch, been adversely affected by humans removing flesh or eggs or whatever. So the intelligence associated with assessing the mortality is very important. So saying, "we looked at a number of turtles and it would appear they were carrying eggs, they were unsuccessful nesters and were caught by the tide, they succumbed to the heat during the day," rather than saying "we saw 30 dead turtles and therefore there must be a subsistence fishing fleet in the area who have been killing turtles." I think this is very important to ascertain the cause of the mortality rather than just saying "yes, there is a mortality". I was looking for something like that in the report that there was 5,000 turtles washing ashore in Gahirmatha. Where was the intelligence of this? It is very easy to point at a vessel offshore and say, yes, it has come from that vessel. But when you are dealing with 600,000 animals trying to nest in one year you are likely to have a very high mortality from natural causes - just sheer natural causes. Even on islands like Raine Island where in excess of 10,000 turtles may nest a night, over the course of the nesting season there will be hundreds of dead turtles on the beach. There will be turtles that are caught by the tide, turtles who have just come to the end of their life and turtles that have expired while nesting. Where you have large numbers of turtles, you have large natural mortalities. This is something that should be looked at when we are talking about "does mortality occur in the absence of shrimp trawling?" Mortality occurs throughout the turtles life and it may be excessive on some of the nesting beaches or larger in non-nesting turtles and may be females are more prone to this sort of mortality than are males.

278. "Do we have enough knowledge to identify all potential hot spots where sea turtles and shrimps interact?" [question 6 by the United States] I think the idea of looking at the concept of hot

spots, these areas where sea turtles will be feeding and by closures of areas likely to encounter sea turtles, you have gone a long way to excluding sea turtles from the trawl fishery. In some of the areas in Northern Australia olive ridley sea turtles feed in very shallow water, feeding on mollusc. They are not actually feeding on the shrimp. They just happen to be in the same area as the shrimp and they feed on shellfish and the like. By having closures in those areas, those turtles would be protected from shrimp trawlers. I think I shall leave Dr. Pointer to say more about that. Question 7 [by the United States], seeing it is directed to Dr. Eckert, I shall leave that question. In question 8 [by the United States], I would like to indicate that it was Dr. Pointer that noted that the adoption of TEDs by a shrimp trawl fleet would take 6 to 8 years. However, I am happy to comment as best I can as to the implementation of TEDs and I welcome Dr. Pointer's opinion as well. I cannot speak for Thailand as to how it produced such an elegant and effective TED within a matter of months. I congratulate Thailand for doing so, but the means by which they did it are best known to Thailand and I would encourage Thailand, to produce some of their documents on the means of developing turtle free TEDs.

279. Australia has been trying to develop trawler efficiency devices, that still goes by the acronyms as TED but has a different complexion to it. The trawler efficiency devices, as they are referred to in Australia, look at making the trawls more efficient. They also incorporate such added extras, as fish eyes, for juvenile fish that are associated as a bycatch with shrimp trawls. They are being developed in sub-tropical as well as tropical waters. They are not driven solely by turtle excluding pressures. They are in fact designed, if I am correct, the underlying assumptions for the trawler efficiency devices, is to sustain fisheries whether they are being commercial fisheries or recreational fisheries and to maintain the profitability of fisheries to prevent fisheries succumbing to financial hardship and also to maintain the viability of fisheries. So there is a cause of concern if shrimp trawlers are seen in the locality where there is a large recreational fishing. The recreational fishers are too keen to point their fingers at the trawling operations offshore. And therefore the trawlers have a responsibility to be able to answer these charges and say "yes, we will adopt trawl efficiency devices so that the juveniles of the fin-fish species of the recreational anglers or the professional fisherman wish to catch are not being harmed by the trawl fishery". So there is a trawl efficiency device that also serves as a turtle excluding device, but I think the thrust of Australia has been ... [tape turnover] ... the efficiency of the trawl, the responsibility, to make it a responsible fishery and to reduce conflict between the shrimp fishery and other fisheries operating in the area. I would like to conclude there and thank you for listening.

Mr. Chairman

280. Thank you very much. I do not particularly wish to put any sort of restriction on the two remaining experts, but given the time I would want to ask them to be as economical as possible in their answers with regard to the remaining time available to us. Perhaps at new points or where they have different views and try to avoid repeating where the material has already been covered.

Mr. Liew

281. Thank you Mr. Chairman. I will skip quite a number of the questions because I think they have been quite well answered by the other colleagues of mine. What I will I do is I will answer the US questions first concerning question 4 on TEDs. I would like to sort of expand it a bit and talk about trawling TEDs and bycatches in relation to trawls that are in use in the US and trawls that are in use in the complainant countries. I agree with Jack here that trawls are very destructive to the environment. It is a very destructive form of fishing and it catches everything in its path: from large animals - like sea turtles, large fish, sharks, rays, large groupers, sometimes tunas (Scombrids), they all get caught in the trawl, pomfrets, bream, all the way down to the very small fish which are the

juveniles of those large commercially important fish. In addition to that, you get crabs, prawns and a whole lot of other invertebrates that are on the sea bottom. Apart from this process of dragging, the trawl device on the sea bed, it sort of scrapes the bottom many times and you may have a productive bottom and it eventually ends up like a desert. So, as Frazier has mentioned, there has been some call to ban the device in some countries but very few have really taken up the ban. Notwithstanding that, if you compare trawling in Malaysia or in the other complainant countries and trawling in the US, for example in Malaysia, when a licence is issued for trawling there is no distinction as to whether it can only catch fish or you can only catch prawns. If they are fishing in an area where there are prawns, then all they do is change the cod-end to a smaller meshed cod-end to catch the prawns. If they are fishing in an area where there are no prawns then they go for the fish and they change the cod-end to a larger mesh so that the smaller trash escapes. Almost all the catch from these trawlers are landed: the large commercially important fishes: the prawns and the trash fish. The trash fish refers to the small fish of the commercially important ones. All this is to provide the badly needed protein in these developing countries - that is why they catch and use everything. The larger fish are important so they are sold in markets, the trash fish they convert to fishmeal or animal feed and then the prawns are also sold in markets and if they fetch a good price then they are exported for the country's foreign earnings. Thus, for many of these trawlers the earnings they get from prawns is only a component of the total earnings.

282. This graph [graph 6, Appendix 2] shows you different years [pointing at the x-axis], the largest column is the trash fish component - that means the young, small fish which they use to convert into fishmeal. This component [middle "fish" column] is the larger, commercially important fish that they sell in the market. This component is the prawn [indicating the right column]. So every year the prawn is this [indicating the right columns]. So, when you put a TED on a trawler like this, ...as you know the TED gets rid of the larger fish. So you put a TED here and this will reduce [pointing at the fish column] - they are talking about losing some of the commercially important fish. This will remain in the bycatch [pointing at the trash fish column] - OK the trash fish in this trawler is the bycatch and will still be there - you do not handle the bycatch. You lose the larger fish. There is a difference in the US shrimp trawlers: this [indicating the prawns column] is what they want and all this [indicating the fish and trash fish columns] they throw away. Their bycatch is the fish and the trash fish because they only want the prawns. So I think that is the difference that we have to be aware of when we talk about putting TEDs on fish trawlers. So we have to look at this problem along the perspective of the fishermen. You are going to introduce a device to fishermen and you want them to comply. You cannot expect them to use a device and find they lose profits in terms of the large fish. When you talk about it [referring to TEDs] being an efficient device which gets rid of bycatch, in this case it is not the bycatch that it has got rid of, it's the larger fish - that is the bycatch that the US are talking about in their shrimp trawler that are excluded with the turtles. Yes, it gets rid of turtles.

Chairman

283. Can I just ask a question. Does the Thai TED take care of this problem or is this something which suffers from the same...

Mr. Liew

284. Well, the Thai TED is similar - it is just a similar device. It also gets rid of the large fish. Because, I mean, logically you look at the design of a TED - all the large animals are got rid of and all the small ones get into the net. Even though the Thai TED is similar, depending on the size of the grid, it would depend on the size of the animals that there are ejected. Even for the Thai TED, they have used it but are the fishermen happy with it? If you look at the most recent reports I think they are not too happy because they are losing fish.

The Ambassador of Thailand

285. Mr. Chairman, I am very sorry but I would just like to ask permission, but I can make certain qualifications as far as the Thai TED is concerned or you would like me to wait until the experts finish their answers to questions. In order not to leave any misunderstanding on this perception about the Thai TEDs. I want simply to say that the Thai TEDs is the response to an embargo imposed by the United States and then we would like to solve these trade problems. That is why the Fishery Department of Thailand has modified in the shortest possible time-frame without having to go through scientific experiment. Of course an elegant TED, as put by one expert. But the effectiveness, I am not quite sure because once we have put in place we still have to monitor and I think it would take many more years before we can say about the effectiveness of this Thai TED. Thank you very much.

Mr. Liew

286. It seems that they have problem. It is good if there is a TED device, if there is some kind of device that would get rid of turtles but then retain the big fish, the commercially important fish, and similarly get rid of all the trash, but still retain the prawns. We still have not been able to get that kind of device and I think this is the reason why the complainant countries have been quite reluctant to introduce TEDs in their trawlers because they still find this kind of dilemma. I think it is time here for research to be done to really work and find out whether we can improve on a device that would help save the turtles but still retain the big fish and the prawns. I would like here to sort of jump to question 8 of the US about how long it takes to adopt the TED. How long will the US be able to help us develop a device that the local fishermen will accept. If they can find a device that is suitable that would be the kind of time-frame and then introduce it to local fish trawlers. The local fish trawlers will be very glad to have a device that would exclude turtles, exclude the small trash fish and retain the big fish and prawns. I will appeal to the US with all their expertise and funding to help and find good solutions to this.

287. I would then like to jump to the question by the Malaysian submission. The first question: "would trade prohibition on the imports of shrimps to the US by itself save turtles from shrimp trawlers?" If the question is would TEDs save turtles, as what Frazier has interpreted it has, I would say yes, TEDs would save turtles. But would a trade embargo save turtles, I would say no and I would agree with Scott, by itself it would not. But by virtue of this case being brought up in the WTO dispute, it has put attention on many governments to the plight of turtles, irrespective of the outcome. This itself is a plus for turtle conservation. However, a shrimp embargo may undermine the efforts of turtle conservation and the protection of costal habitats especially in Malaysia. How is that possible? Because with the threat of an embargo it will carry a message that shrimp trawlers are the single most important cause of decline of sea turtles. Together with that message, it will also say that it is OK to continue with the present level of egg harvest, or even increase the level of egg harvest, because shrimp trawlers are the problem, not the egg harvest. Together with that message, it may also go with the message that it is OK to continue with the hunting of turtles for meat, because shrimp trawlers are the problem, not hunting. I mean you look at the irony of the situation of the shrimp trawler: he stops or is caught because he did not have a TED on his boat, even though he did not have any dead turtles. Just because he did not have a TED he is stopped and he is penalized. At the same moment a boat passes by, with 20 or 30 turtles going to the slaughterhouse. This situation is happening in Costa Rica where they allow slaughter of turtles but they use TEDs. They slaughter turtles for cosmetic [products] - this is happening in Bali, in Indonesia, where slaughtering is still rampant. It is very ironical. Another point is that it will also give the message that TED is more effective in protecting turtles at sea than closed areas as what we have in Malaysia for trawling. Trawl fishermen will then

use this to fight for the lifting of zoning. They say "we have TEDs and we protect with environmentally friendly device so why can we not come in and fish in a nearby zone". They may use this as a case. Another point is that TEDs are not required if you do not export your prawns to the US - this is what the embargo is going to be. It will leave that kind of a message: TEDs are not required if you do not export your prawns to the US. So trawlers who do not export their prawns to the US will argue that they need not use TEDs. It is already happening. We have reports from fishermen from places who say "we do not export our prawns to the US, why should we use TEDs?" This creates a serious obstacle to the Fisheries Department, to the turtle conservationists who are presently experimenting with TEDs to try to introduce to these fishermen. We do not want to give them that message that if you do not export your prawns to the US, you do not need TEDs. We are still working on trying to find a suitable TED to introduce to them. Another point is when affected countries see they cannot sell their prawns to the US, they look for other markets, like Michael Guinea pointed out. Instead of using TEDs to save turtles, the fishermen would instead just look for other markets for their prawns. The purpose of the embargo will be defeated. They will sell their prawns to countries that are exempted from the embargo, like Japan or Singapore. These countries will repackage it with other prawns from aquaculture and ship it to the US. I feel that embargo is not the solution. It may create more problems to turtle conservation. I agree TEDs will help but you have to design a TED or produce a TED that is acceptable to the fishermen. You have to get them to accept and not force it on them. Fishermen are proud people - you force them and they will not do it. If there is an option of other markets, then they will just look for other markets.

288. I will go to the second question of the Malaysian submission. My other colleagues have brought up something about population sizes and long-term monitoring before you can detect whether a population has recovered or not. So they mention that you require very long periods of population monitoring because there is very high fluctuations and then you need many, many years before you can really say that the population is recovering. There are populations that I have here that show signs of recovery. Probably most of you have seen this [graph 7, Appendix 2]. This is the leatherbacks in St. Croix - quite a few years data and there appears to be an increasing trend and they are recovering. I am not saying they have recovered but they are in the process - the recovering process. This is the leatherbacks in South Africa. It has a very long dataset, ... many years, you can see the trend - they are recovering. Similarly, the green turtles of the Sabah islands [graph 8, Appendix 2]. There has been a decline but then they are recovering. If you talk about wide fluctuations, it is there, but if you follow the trend, they are recovering. So the efforts of these conservationists - they have spent many years working on this and getting the populations to recover and they are showing signs of recovering. You just cannot step in and say it has not recovered. How would they feel? They would feel they have not done something that is good. We have to recognize that they have done a good job. We have to recognize that the population is recovering. By the same token, it is very slow for us to recognize the populations are recovering but it is very quick for us to recognize that the population is declining. Why? In 5 years you find out the populations are going down very quickly and you jump up - it is declining! Why do you not give it 20 years. By that time it is too late. Recognition has actually been given to this population. They have been given awards for the fact that they have worked very hard to recover these populations and we have to recognize that it is so. Not only just recognize that, but it gives us hope. There are many populations that are down and we are using the recovering populations as examples that if you do conservation work properly, nesting conservation, there is a hope that your population will recover. For us, in Terengganu, our leatherbacks are very, very low and there have been talks in the state about forgetting the nesting beach and develop it for tourism for hotels. We are standing firm and we say "there is a chance that we can recover populations, look at this population [referring to graph 7]." We are using these as examples that populations are recovering.

289. Something that Jack Frazier submitted is the TED technology transfer. Yes, the US have worked very hard to try and transfer the technology of TEDs to many countries. But if you look at the

amount of transfer of technology to the complainant countries I think it is nothing more than just the complainant countries requesting for the information about TEDs. I do not know whether you call it technology transfer or not, or it is just for getting information. For example, in Thailand - I was going through the letters to see what actually transpired - Thailand initiated a request for information about TEDs in 24 April 1992. The US did not respond until January 1993. In both cases it was just sending information, requesting for information and sending the information. There was no offer by the US to run training workshops or join research on TEDs or anything like that. It was not until September 1996 that one workshop was held in Thailand and that was after the embargo. In Malaysia also all the correspondences are just request for information. To Pakistan there was nothing. To India, the first correspondence was in 1982 - it was a request for information on TEDs and in August 1992, India...

The representative of the United States

290. I do not know what this is in response to. This is not a question, this is a recitation of which apparently appears to be from the various briefs of the complainants and I think this is inappropriate. We have been holding our fire, but this is now getting out of control.

Chairman

291. I wonder if we could just try and keep to the questions as they are framed and move along because we are now getting very short on time and we still have one other speaker.

Mr. Liew

292. Basically, what I am trying to say here is that use of TEDs cannot be applied straight away. You cannot take from one country and straight away apply to another nation. There has to be some kind of work done to see its suitability. I feel that the US has not really come out to work with the complaining countries to transfer their technology.

Chairman

293. Could we just keep to the scientific aspects of the question because that is getting more into the subject matter of the dispute and away from the scientific facts which is really the purpose of the expert process. I am sorry to interrupt you but perhaps we could try and deal with the scientific bits because time is getting a little bit short.

Mr. Liew

294. Well, basically, OK. I will then end by saying I am a turtle biologist. I am just as concerned about conserving sea turtles as turtle biologists in other countries. I have written, we, in Malaysia have written, for information about TEDs and we have also suggested to our Fisheries Department to try and work and develop TEDs. But, all in all, I just hope that TEDs should be introduced in a more friendly, cooperative manner. I do not think that trying to get people to comply with TEDs by an embargo would solve the problem and I shall end here. Thank you.

Chairman

295. Mr. Poiner, there is not a lot of time left. We have now got some questions that have been put forward by Thailand and these have been circulated in writing [see Appendix 1]. Necessarily, the answers are going to be rather brief because of the remaining time. In addition to the other questions

perhaps I could ask you to look at those and then I will give the other experts also an opportunity to say something briefly on those as well.

The representative of the United States

296. Mr. Chairman, before we go to the Thai questions, I would ask that you look at the first two on the second page [questions 2 and 3 by Thailand, Appendix 1] which are really not a question. It is not a scientific question but just ask the experts whether they know something about Thailand - it is not really a scientific question and the second question is not really a scientific question either. I guess the second question would be "are they effective?" and premises falls "are the experts aware that Thai TEDs have not been found effective?" when there is a scientific study showing that they are effective. So you cannot ask a question, with a false premise. I would ask that these questions be struck or re-phrased.

Chairman

297. I can certainly see the point on those first two questions but the third one on time is one that bears on something that we have already been discussing. I do not think that any of these, because they are in fact bearing on matters which have been extensively covered already, actually require very much time in the answers at any rate. So perhaps the experts could bear that in mind. Mr. Poiner would you like to continue please.

Mr. Poiner

298. Thank you. I will start with the Malaysian questions and in the interest of time I will try to be as brief as possible. Turning to the first question to all experts relating to the trade prohibition, I think there is really two aspects to this. The first is the trade issue, in the sense that if a country is not exporting to the US, then a prohibition would have little effect. Australia is a good example of that. Very little of the product goes into the US and unless there is subsequent indirect impacts on the market in terms of realigning where the product is eventually going, that would have very little impact. There is also a biological perspective on this in terms of the use of TEDs. I think I shall try and briefly summarize what my view on this would be. My professional view is that I think that the current data on the incidental capture of sea turtles in shrimp trawl fisheries offers an estimate of trawl induced mortality and allows comparisons with other sources mortalities. For some species and some breeding units, I think that current data does not give a clear indication about the effects of these mortalities on the turtle populations, apart from probably some of the US examples. But the evidence does suggest that it is an important source of mortality for many species and breeding units. Given that, I think we have heard about the precautionary principle and I think that is a valid principle in terms of managing these sorts of issues. I think there is a need to reduce the capture of turtles in trawls, but I would emphasize that needs to be part of a wider programme to reduce all sorts of mortalities and that part of that programme is identifying the source of mortality for the breeding unit that you want to manage. Finally, the use of TEDs is one of several possible measures that could be used to reduce turtle captures in trawls.

299. I will now move on to the second question from Malaysia in relation to acceptable recognized methods of determining population sizes. We have heard a lot about this and I can generally concur. I just want to make the point that there are three issues that are critical here. One is the determination of what is being called breeding unit and there are methods that relate to things like genetic methods, tagging methods and a variety of others. Then, there are other ways of measuring trends in populations, because the key to this is determining the trend in a population. Most of these revolve around breeding females at beaches and the important issue there is to be able to be detect trends over long periods of time. Those periods of time are a combination of the life history of the animal being

studied and for these turtles that is a long period of time - 10, 20 or 30 years is not unexpected. There is also the factor of the biophysical events that impact on those populations and the best example we have all heard of is the impacts of the "El Niño" phenomenon in the West Pacific populations. The important issue is identifying the breeding unit and then having statistically robust estimates of the population that you can use to detect trends over the appropriate time-frames. Our methods will be improved, they will change and that is part of the process. Moving on to question 3, I will just simply say that I think the concept of a breeding unit is a key and critical concept. That is what we need to focus on in developing management strategies for these animals. Question 4, in general I agree with most of my colleagues - great care should be taken in generalizing any data outside the areas studied but it really does depend on the study and depend on the question being asked. Jack's answer to this was a very good one in the sense that if you are studying green turtles in the Atlantic and show that they do migrate, I think it is a reasonable assumption to help you frame a question for Pacific green turtles that they are also likely to migrate. It can be done but should be done with great care and then should be followed up by studies to get the data specific to that population.

300. Moving on to question 5, that there are sea turtle populations which are quite healthy, I too would have to question the use of the word "healthy". I think that is a fairly difficult word to define in terms of a population study. I think there are a few examples of breeding units which either have not shown the drastic declines of many populations - probably a reasonable example of that is the Raine Island population. I should have made the note that I too think that these questions need to be framed in terms of time-frames and the time-frame that I have assumed in this is about the 20- or 30-year period for such data. Assuming that sort of time-frame that we are looking at, then I think there are a few examples of populations that have not shown drastic declines and the South African one is a good example of populations that are probably increasing. But I think for most stocks there is a general agreement that populations are at low levels and I think that there is still debate about the nature of recovery and if recovery is occurring in those populations.

301. Moving on to question 6 of the Malaysian submission: what species are the dominant species impacted by trawling. This, like a lot of things that we have heard today and yesterday, this really does depend on the fishery and the distribution of the turtles in respect to that fishery. We do have 4 fisheries where we have very good data looking at what species and where the important species are impacted, coming from the US and Australia. In the US, in one of those fisheries, it is loggerhead that is certainly the major species being impacted or was impacted and that is the Southern Atlantic in terms of the Gulf of Mexico - loggerheads and Kemp's ridleys. However in Australia, for example, the Northern Prawn Fishery, it is flatbacks and olive ridleys which are the key species impacted and on the Queensland Eastcoast it is loggerheads and green turtles. So the point I am making is, it really does depend on the fishery. I think some care is needed in making global generalization based on data from one area.

302. Moving on to the United States questions: the simple answer [to question 1] is yes. Yes, although I think, and my colleagues have expanded to some extent, but I think these sorts of questions -it's over-simplifying a very complex issue and I think that in dealing with these issues, one needs to be quite careful and quite specific to the fishery or to the breeding unit or to the species that you are addressing. I think we have spent quite a bit of time on that. I guess in terms of this, the questions themselves are a bit of an over-simplification of the situation.

303. Moving on to question 2, some of my colleagues have referred to the numbers games. I note that really what we are talking about here is interpreting complex data and data from a variety of sources basically using modelling techniques. I think, in using modelling techniques, they are essential and they are probably one of the few tools that we have to really look at predictions of the impacts of management measures over long time periods. However, in using those modelling

techniques, we need to be very careful in terms of making very clear about our assumptions because, as I said yesterday, assumptions being made in our models and how we deal with some of the uncertainty in our models.

304. I think what you will find is that tools are very good but if we do not clearly state those assumptions and those uncertainties then it is very difficult to interpret the outcomes. I will use the example of Crouse and Crowder models which demonstrate that the impacts of trawling on sub-adult and adults potentially do have a major impact on the population. Similar models by other people, for example, Somers in Australia, where a slight modification of things like egg and hatchling stage mortality rates come up with a somewhat different picture. Then more recently, studies by Chaloupka and others, who use different sorts of modelling approaches and somewhat different assumptions, come up with indications of the importance of managing to control for egg mortalities. The point I am making here is that these are very valuable, very useful tools. However, we should be careful in terms of over-simplifying some of the numbers that are used in these tools and we have a bit of an example of it here. Moving on to question 3. Again I think the simple question here depends on the breeding unit and the source of mortality in terms of determining the relative importance of minimizing mortalities from shrimp trawling. Again I think we have had quite a lot of discussion about that and I do not need to say much more. Moving on to question 4. Again, properly installed and used, yes, TEDs are very effective eliminating turtles from a trawl. However, in my answer to question ... [end of the tape] ... if you have a properly installed TED in a trawl and a turtle enters that trawl, there is a very very high probability that that turtle will leave that trawl without being caught in the cod end. Moving onto question 5, I think my answer to one of the Malaysian questions and I won't repeat it, basically what I would say is that the current data does demonstrate that for many breeding units the incidental capture, not for all but for many breeding units of some species, the incidental capture of turtles in shrimp trawls is an important source of mortality. The data, apart from one or two populations, does not give a clear indication about the effects of these mortalities on the breeding units or the populations, or the stocks themselves. However, again, I think that it's rather prudent to reduce the capture of turtles in trawls but again not in isolation of other measures to reduce other sources of mortalities. By themselves, I doubt whether that would effectively conserve these populations.

305. I think I will move on now to question 6, time and area closure. I would like to spend a few minutes on this Mr. Chairman. A little bit of comment on approaches to fisheries management: there are generally two approaches, what we term input controls and output controls. Without going into great detail, shrimp fisheries are generally managed on input controls simply because of their short life period. Most shrimps you are talking about, one or two years max. and because of the variability in terms of the natural variability in the catch from environmental processes. What this means is that things like total allowable catches and ITQ management systems really don't work for shrimp fisheries and I can't think of an example where they are applied. What that means is that they generally use import control measures and they will range from things like gear restrictions and gear modifications. These are commonly used in, if I'm correct, the Gulf of Mexico, together with other management measures such as area and time closures. Now I think again we should be very careful of generalizing about some of the measures used for one or two fisheries to all fisheries and it's not correct to suggest that area and time closures are important and very useful and very effective measures used in fisheries management particularly for species like shrimp. They generally use the things like the protection of critical habitat. For example, many species of tiger prawns, which are very important species in the Pacific, as juveniles only live in sea grass communities. Hence, if you are going to manage that fishery, you have to manage the sea grass community. Similarly, for many of the white shrimp only live in mangroves. So, often you will find in this part of fisheries management you'll have permanent closures of shallow water areas that are supporting for example sea grass communities. They are also used to enhance the value of the catch, so you'll tend to have time closures to maximize the return on the size of the products. So for example, you'll find that

there'll be what's called pre-season monitoring of the size of the catch so as to maximise the value of the catch when it's caught. Because, for example, the Japanese market like shrimp about this big and the difference between the returns on a shrimp that big and that big are quite large, so time closures we use for that. Time closures are also used to enhance recruitment. For example, you get periods when the fishery is shut down around breeding times actually to enhance, for example, egg production. They are also being used to minimise interactions between fisheries. One of the two examples I can think of is Indonesia with the in-shore traditional and artisanal fisheries being separated from the larger industrial trawl fisheries. Similarly in Northern Australia, in Torres Strait; you get a similar example in Papua New Guinea. These are well and commonly used techniques and management tools in many fisheries. In that, they offer an opportunity to be useful in terms of turtle management of the incidental catch of turtles. So I can think of two examples of this that I am well aware of, both directly and indirectly. An indirect example would be probably in the Northern Australian prawn trawl fishery for example, the lower catch rate of green turtles compared to the East Coast prawn trawl fishery, probably can be explained simply because of a permanent closure of shallow water in the Northern prawn fishery to sea grass communities. The closure has driven the fleet, if that's the correct word, further off shore than say the corresponding East Coast prawn trawl fishery. Another more direct example is in a place called Mon Repos, near Bundaberg on the East Coast of Australia where it is a loggerhead nesting area. Seasonal closure of trawling off shore which is in place now, I think will be effective in terms of reducing the trawl catch of those breeding females as they migrate to that beach. I don't think we should exclude area and time closures as a potential tool for the management of this issue. However, like all these things it will depend on a variety of other things particularly the nature of the fishery, the nature of the socio-economic issues surrounding the fishery and all those sorts of things.

306. Do we have enough knowledge about hot spots? [question 6 by the United States] No we don't. For some breeding units we do, for some areas we do, again these generally come from places like for example in Australia, where we can identify different catch rates of turtles in different areas of the fishery, both in relation to the feeding and breeding areas. But, generally that information is not available. I will skip question 7 because that is addressed to Dr. Eckert. The final one, the adoption of TEDs by shrimp trawling fleets [question 8 by the United States]. In my comments yesterday, I used the example of the introduction of bycatch reduction devices, including TEDs, in the Australian shrimp trawl fisheries to demonstrate that this is not necessarily a quick process, because in many of the documents surrounding the case is that this is an issue of a matter of months. The example I used in Australia where it is probably going to take 6 to 8 years (I'm not saying that it will take 6 to 8 years in every area), but I think that by the same token it's somewhat naive to think this can be done in a matter of months. I say that because really, the introduction of these sorts of devices in the fishery is really a three stage process. The first process is the identification of the device that potentially will do the job for you and doing the job depends on what you want to exclude. For example, I note that the earlier comments about elimination of trash but retention of large fish that my colleague Mr. Liew made. There are two types of bycatch reduction devices. There are types that work on basically mechanical means and that's often the TEDs: they're actually rigid structures in the net that a large object like a turtle will hit and be forced out of the net. There's also other devices that work on the relative swimming ability of the animals being caught. So these are often used to eliminate the trash species, so basically there's things called square-mesh panels, fish eyes, a whole variety of things that now basically work on the assumption that fish can generally swim a lot better than prawns, so the fish move down the net and swim out these holes. There are also devices that use a combination of these things. For example, you might want to eliminate large animals plus so some of the trash. So really you need to identify what you are trying to do and then select your device. Now, the device will need to be modified for the individual characteristics of the fisheries and by that I mean it relates both to the types of nets being used, the types of vessels being used, the types of fishing strategies being used but also relates to issues in terms of types of environments being fished. So, for example,

in some areas of shrimp fishing, where there is a large community of animals that live on the bottom, particularly sponges, they tend to clog a lot of the rigid TEDs; so again you need to develop ways of overcoming those sorts of problems. You really need to identify the device and demonstrate that it is effective and that's what we have been talking about in terms of properly installed TEDs to eliminate turtles. That's only one part of a three stage process. The next stage is the extension of that gear or gears into the fishery which is really similar to most agricultural fisheries or whatever processes where you want to change the behaviour of a group of people, be it fisherman or farmer; it generally involves an extension process and the length of that really does again depend on the particular nature of the fishery. What I'd think is the final part of the process is what I call the formulation of the use of the gear to the management plan or the way the fisheries are managed. That's when you get into the issues of whether you are doing a regulatory approach, i.e. compulsory introduction, or are you doing as what I talked about, a target approach. So, you are setting a target and how you achieve that target is really up to the fishery. I think it is important to realise that this is not simply a process of demonstrating this device will eliminate turtles, it's a process of demonstrating that in the extension and then the capture of that information and formulation of that information into the management plans that govern those fisheries. Mr. Chairman I will try to deal with questions raised by Thailand although it might be more efficient to rotate through and I can read this, as well as my other colleagues.

Chairman

307. Yes, perhaps I can just say that since the time is now reached almost one o'clock, I think I would like to give the experts each at least one last opportunity to say whatever few brief summary words they want to, or add any other points they would like to at this stage. Perhaps they could, in doing so, add any brief answers that they may have on those Thai questions and incorporate that together. We've had, I think, all the questions and points from the parties and I don't intend, unless there's any reason to do so, to offer the floor to the parties again and perhaps we can just go into the final round and, as I say, include the answers as far as possible. But, please try and be as brief as you can. Dr. Eckert.

Dr. Eckert

308. I will try to break my typical mould here and I'll go through this promptly. Let me deal with the questions first [questions by Thailand], just briefly. The first four questions and the first three questions deal with the application of TEDs in a fishery. From my own experience, what I can say is, having worked with shrimp fishermen on the Georgia Coast for a number of years before moving to California, TEDs are not difficult to operate, they are a very simple device. However, as Dr. Poiner pointed out, fine tuning or modification of the basic design is very important to the individual fishery. I know there has been tremendous work done on that. In the United States they instituted a programme of TEDs certification, by which shrimpers can develop their own TEDs and bring them to a certification programme and get them certified as being a viable TED, that would work in the kind of environments that they were working in. That apparently has been very effective and quite creative developments in efficient TEDs. "Mandating TEDs requirements is not guaranteed that sea turtle mortality will be reduced?" Like all laws and regulations I don't know any of us that actually drive the speed limit either. The enforcement of a regulation is only as good as its enforcement. However, if one shrimper uses the TED, the turtle mortality will be reduced. I think we are all in agreement that TEDs reduce the take of sea turtles and so if one person follows the law, it's going to be in that game for the sea turtle populations. On the second page relative to the first two questions [question 2 and 3 by Thailand]. The answer to the first question, no, I was not aware of any developments in the TED, the same thing for the second question, I am not aware of any expert testing the TEDs other than there was one brief report included in our briefings provided. Relative to the last question, it would depend

on the situation, the country, the fishery and so on and so on. I'm probably not in a good position to speak to that.

309. Final comments, you have heard a lot of testimony in the last day and a half about sea turtles. The take-home message is that global sea turtle populations are in trouble. I think we are all in agreement with that. There seems to be a message that TEDs reduce mortality in sea turtles and that shrimp fisheries often, if not always, provide a source of mortality to sea turtle populations. I think we are all very clear on that. You heard some discussion about the biology of the animals and where we agree and disagree and how we are trying to play the numbers games and trying to understand what is going on out there. All that stuff is reflective on more of a management decision that has to made as to how are your resource management dollars best spent and how are your resources towards conserving sea turtles best spent. You have heard from us that we could probably go on for another three or four or five days on that same issue. It would be up to the individual countries as to how they approach that. But, I think that we are all in agreement that you need to take a balanced approach to the conservation of your turtles. You need to address them in the water as well as on the land and all aspects of their life histories and so that is what I have for my conclusion. Thank you.

Chairman

310. Thank you very much indeed. Doctor Frazier.

Dr. Frazier

311. Thank you for your patience with us. The first page of questions from Thailand, I know that Arauz from Costa Rica has been working with TEDs with the fishermen in Costa Rica and he has told me that he does not think it's difficult - you have to work with the fishermen. I have worked with Gabriel Olguin in Campeche in Mexico, and Gabriel is convinced that it is not that difficult in Mexico to use TEDs. It's a matter of will, I think. If the fisherman wants to do it, he can learn to do it. It is like any kind of gear, it has to be learnt. I have said that before, it is not simply a matter of sticking it in the net and it's magically going to work. Other colleagues have mentioned the need for training and I am in total agreement with that. But it is not difficult to use properly, I don't believe it is difficult to use properly. "TED requirements are very easy to evade and many shrimpers ...". Well, there are two parts to the question. Are TED requirements easy to evade? Yes, all requirements are easy to evade. Drug import requirements are easy to evade, gun requirements are easy to evade, all requirements are easy to evade, it depends on the will of the person. The second part of the question, well perhaps Liew mentioned that if people are against them they won't use them. It depends on the shrimpers. This is why Ian pointed out the need for extension. Clearly the shrimpers must be working with the fisheries people. Part 3, "TED requirements are not easily enforced". Again I think that's a re-phrasing of the earlier question. Any requirements can be evaded. Perhaps to put this in context one needs to look at this with other sorts of requirements. It is my impression that area closures, I tried to mention before, I believe area and time closures are very useful, and I believe there are excellent laws that exist that address those issues. However, depending on the characteristics of the fishery, as Ian pointed out, those might not be effective and it may be easier to put TEDs into shrimp trawl nets. Another reason which I tried to explain before is, I see this not so much as a technical problem, but as a social problem in biological conservation. To try and impress upon trawlers they must be more selective, they must use their gear better. They should go towards a step to reducing this tremendous destruction that is caused by bottom trawling. The fourth question "mandating TED requirements does not guarantee that sea turtle mortality is reduced". Definitely not. We can mandate everything we like and nothing will happen unless there is a response by society. We can mandate against drugs, we can mandate against poverty, that won't get rid of it. But, if we don't make some effort to impress society, what are our options? Do we sit and wait? I don't know.

This is a political question really, I don't see this as a biological question. It is a very relevant question.

312. "Are the experts aware that Thailand was unable to develop the TEDs within the short 4 month period provided by the US measures?" Again, I think this is really to be answered by a Thai fisheries expert who was involved in this. This is not something I have been involved in. I do know that Thailand made a major effort to send fisheries experts, I believe to the NMFS laboratory in Pascagoula [Mississippi, USA], if I'm wrong I can be corrected. I'm very certain they sent their fisheries people to Mexico, to see designs that were in use in another country outside the US. I believe Thailand made a major effort to learn from other experiences and to adapt this. That's about all I can say on that question. "Are the experts aware that the Thai TEDs are not found effective in actual use?" I know of very little about this, I have tried to assemble the information I can get. There is a fisheries expert at Bandit at SEAFDEC. If it's necessary I'll find it. There is one report published in the proceedings of a regional meeting where an expert from Thailand reported having testing TEDs, the Thai Turtle Free Device, and that clearly shows that, as far as he was concerned, it was functioning. I have looked through that report quite carefully and my impression is that he was convinced that it was working well, that it would be usable in Thai waters. Now, that same reply seemed to come from another report from Malaysia published in the same meeting and another report coming from the Philippines, I have cited those in the Annex on bycatch. So, my impression is that fisheries experts in three countries in South East Asia feel that the Thai Turtle Free Device is useful. Perhaps, implicit in this question is a submission I think that came with Thailand about an analysis which was done this year. I don't remember the author's name. Now, this showed that there was a tremendous loss of economic value from the use of the Thai Turtle Free Device. The difficulty I have in interpreting that, is that the analysis was done based on 1995, I believe, when the Thai Turtle Free Device was not used and then the next year when the device was used. So, in the first instance we are comparing between two years as well as, with or without Turtle Free Device. So, we have several complications in interpreting the data. What concerns me for many reasons is, if I look at production of prawn from Thailand over those years, I see a decline. Firstly, it concerns me that there is a decline and that's general throughout most regions, there has been a decline. But it also concerns me in interpreting the data because if there is a decline then it means comparing one year and then a later year, I can't tell whether anything I've changed in my fishery is due to that change or to the decline which is in the background. So, I have difficulty in interpreting that data.

313. Finally, "do experts believe that four months is sufficient time to ... all steps necessary?" It is a very short time, I would much rather see more time. Other experts have expressed reasons why. I think that Thailand has shown that with political will, these things can be done quickly. I would much rather see more time for many reasons. I believe, however, that in many countries the fisheries experts have been expressing a need to do this for years. There is an FAO document, which I have cited in the Annex, where fisheries experts concluded that they are really not being listened to. Excuse me if I overstep my role, but please make sure that your fisheries people get this support, they need it, this is imperative. So, I would like to say that this is very frustrating, that there is so much to discuss and so little time. In general, I don't have any contentions with the generality of the comments, there are a few fine things that I think we could discuss further. The focus of the comments of other colleagues, I am in agreement with. As I said, there are fine points which I would prefer to discuss further. Michael mentioned something which, I believe, is valid and that is the value of these environmentally friendly shrimp, what's happened to that? Now, something which I was not able to include for lack of time, there is an attempt now, curiously by the organization which pushed this through the courts, the Earth Island Institute, to make shrimp caught in trawls which have TEDs more valuable, "turtle friendly shrimp", and make it marketable, economically more useful. So, I believe that there is every reason why the countries represented here should make use of that. Sell their shrimp at a higher value, make the consumers assume these social and ecologic costs which are now externalised. I don't see any reason why they shouldn't be doing this. Again this is outside my

purview, I am not an economist, but I don't see why they shouldn't. As I said this is very frustrating, we have opened such a tremendous number of Pandora's boxes. This could go on for years and we are quite capable, but I better shut up.

Chairman

314. Thank you very much. Mr Guinea perhaps you can be equally brief.

Mr. Guinea

315. Thank you Mr. Chairman. I will address the first three questions (a), (b) and (c) [question 1 by Thailand]. These three questions are all related to the willingness of fishermen or boat operators to accept TED technology and, associated with, there this is also the trust that is generated by the sea turtle experts in saying that you need to use TEDs to protect sea turtles. Now, that trust component is a very difficult thing to generate externally. Trust is far better generated internally within a country, if a country has made a commitment and believes that what they are doing is the correct thing, then this trust will flow through. When we are looking at generating trust you can look at the long-term goals of survival of sea turtles, where that may be an element of generating trust or you may be looking at short-term goals, such as producing more value for a product. However, if the fisheries are unwilling to adopt TED technology, then all these problems associated with implementation, enforcement and non-compliance will continue. So it's generally a matter of generating trust within a country. Mandating a TEDs requirement, there's no guarantees in biology. I think nobody's going to give you the guarantee that TEDs are going to be the sole answer to sea turtle conservation. They may make a contribution to sea turtle conservation and that contribution may vary from country to country, from breeding unit to breeding unit and also from species to species, but there is no guarantee. I was also going to make one comment relating to Dr. Eckert, to his example of speed limits. I would just like the record to show that I do drive at the speed limit and not otherwise. On the second page the first two questions [questions 2 and 3 by Thailand] I believe we are not dealing with those. Relating to the third question [question 4 by Thailand], I believe that 4 months is insufficient time to have a technology developed, not only from the physical but also developing a trust within the fishery that this technology is for their betterment. I would not like to put a time-limit on the development of TEDs. I think TEDs are going to be in those areas even in the United States, I imagine, they will undergo refinement, improvement, modifications. We've already seen things such as the soft TEDs removed from some areas. There's arguments over top shooting and bottom shooting TEDs, so I think TED technology is not going to be static, but I think if a country is going to implement TEDs, then it should be done on a basis where the operators of the vessels adopt the use of the TEDs for either the betterment of the fishery or their own financial gain or for some goal. So, the implementation of the TEDs should really take as long as required.

Chairman

316. Thank you very much indeed. Any final words Mr. Liew?

Mr. Liew

317. Thank you. I'll try to make it short for fear of overstepping my bounds. Actually I'm in total agreement with what Jack Frazier has said, so most of the things that he said is similar to my views. There are a few things that I want to raise, some slight changes. Basically, it is in the Thai TED where he did mention about the recent report in 1997. I agree using 1995 data and comparing it with 1997 data, it is hard to accept, but I suppose for Thailand that was the only data they had. What should have been done was to have some trawlers without the TEDs and some trawlers with the

TEDs, operating in more or less the same area and then you compare them and that would give you a much better indication as to whether it works or whether it doesn't work. Nonetheless, if you look at the indepth report, they also mention things like operating costs and they found that with TEDs the costs of operation seem to have increased, in terms of usage of fuel and all that. Those things you can take but not so much on the catch rate, you can't compare between 1995 and 1997. In general, to close, I'm really sort of not against TEDs neither am I against turtles, God forbid. The problem is the incidental capture of turtles in trawlers. They do exist and TED is a possible solution. The complainant countries have, I don't know whether I am overstepping my bounds here, but the complainant countries have been sort of slow in addressing the problem. I mean it took them something like 15 years or so before they started looking at TEDs. This was probably because of the apprehension they have of using TEDs on the kind of trawlers they have, which target fish and prawns. So there is this apprehension. So, I mean the US here will be in the best possible position because of the expertise to come in to help develop a much more suitable technical TED. They may start with a simple TED but it has to be done with proper research and studies, not trying to get all the fishermen to use it and then they start to complain about it because it doesn't work, they are loosing a catch and all that kind of thing. You find that they don't comply and then it is very hard to convince them to accept TED usage. It has to be done in a way where the fisherman sort of accept the device. It has to be done that way. I think I'll end with that, thank you very much.

Chairman

318. Thank you very much. Dr. Poiner.

Dr. Poiner

319. Thanks Mr. Chairman. Firstly, just addressing the questions of Thailand. Again briefly in terms of [question 1 (a)], I think it really does depend on the implementation process and the attitude of the fishers in terms of how difficult or otherwise TED use with time is in the fishery. In terms of the other questions that TED requirements are easy to evade, yes, again if fishermen want to evade something, they will tend to work out a way of evading it. Similarly, in terms of where TEDs are required, again evasion you can do it again. It highlights the need to have the support of the operators, in this case the fishermen, in terms of the use of gear modifications like TEDs, if they are going to be incorporated in the fishery. "TED requirements are not easily enforced." Many, if not most requirements of fishers at sea are difficult to enforce and will always be an issue and always expensive, so the answer is yes. "Mandating TED requirements does not guarantee that sea turtle mortality will be reduced." I will agree with that. Mandating TEDs will not ensure sea turtle mortality will be reduced, however, appropriately and properly implemented regimes that could or may or may not include TEDs could help in terms of reducing turtle mortalities. In terms of the other questions, I was not aware of the first two points, so I will say the answer is no, I am not aware of it. Do I believe that 4 months is sufficient time? Definitely not. I don't think 4 months is sufficient time to effectively implement those sorts of changes in any fisheries, let alone the fisheries like the complex trawl fisheries in a place like Thailand. In terms of final points, again I will just make the final point that I too, like many of my colleagues, have the view that the turtle stocks, many if not most turtle stocks are severely depleted, in low numbers and I think it's very important that we do something about it and doing something about it means trying to eliminate some of these anthropogenic mortalities. Also it's clear for many populations and many species that incidental capture in trawl fisheries is an important source of mortality and I think that we need to reduce it. However, we should not make what I think would be a fatal assumption that just reducing that source of mortality would be the solution for the species. I think that reduction needs to be in the context of a wider programme to reduce all the important source of mortalities because we really at this point cannot distinguish between them for many of the populations. And I finally make the comment that I have made several times is that the use of TEDs is only one measure, but only one measure, of several that are available, that may be useful in terms of reducing full capture of sea turtles. Thanks Mr. Chairman.

Chairman

320. Well thank you very much. I think at this stage I would like to express my thanks to all the experts. They've given us both yesterday afternoon and today as well as in writing before that the benefit of their wisdom and I certainly think they have helped very considerably the work of this Panel by giving us a very good picture of the scientific and technical background to the problems of sea turtle conservation and sea turtle behaviour. So, I would really like to express my very warm thanks to them for that. I think that concludes our work today and I would like to thank everyone for participating and in particular our experts who have been so helpful and so patient with us and with our questions.

Thank you very much indeed.

Appendix 1

QUESTIONS BY THE PARTIES AT THE MEETING WITH THE EXPERTS

Questions by Malaysia

To Dr. Eckert:

1. You have formulated a hypothesis for the migration of leatherback to justify US jurisdiction over the sea turtles stocks of Malaysia, Thailand and Indonesia. What hypothesis can you propose to justify US jurisdiction over the sea turtle stocks of India and Pakistan?

2. You have not provided answers to the question "Are you aware of data on the rate of turtle stranding in areas where TEDs are currently required or on the relationship between turtle stranding and shrimping activities in areas where TEDs are required?" Data released to the CTURTLE List through the internet has actually shown that turtles still strand in large numbers even as recently as 1997 in areas where TEDs are required.

3. You have worked on the leatherback population of St. Croix. What were the major conservation measures taken there? Would you say that the population there is showing signs of recovery? What was the nesting population size when you were working there in the mid-1980s? What is the current nesting population size? Would you say that protecting the nesting females on the nesting beaches, and protecting the eggs undergoing incubation have contributed towards the build-up of the nesting population in St. Croix?

4. Malaysia has submitted rebuttals to some of the points raised by you in your responses to the questions from the Panel. We would like to have your comments in writing.

To all the experts:

5. In you expert opinion would trade prohibition on the import of shrimp to the United States by itself save the sea turtles from shrimp trawlers and extinction?

6. What is the acceptable recognized method of determining the population size of breeding units of sea turtles, especially in assessments of population trends?

7. Please tell us your views about the concept of unit stocks or populations or breeding units of sea turtles.

8. When studies on any particular sea turtle population are made, would the results apply to the population being studied, or would you as a scientist, generalize your data for all sea turtles, irrespective of the species or where they occur?

9. Notwithstanding the status listings of sea turtles provided in the IUCN Red Data Book and CITES, would you not say that there are sea turtle populations in the world which are quite healthy and which have benefited from long term conservation programmes started some 30 years ago?

10. Data provided by Henwood and Stuntz, 1987 and numerous other reports of turtle mortalities in shrimp trawls, as well as stranding data show that loggerheads are the predominant species impacted followed by Kemp's ridleys. Based on all scientific evidence available, and the feeding

habits of loggerheads would you agree that the loggerhead turtle is the species which is most vulnerable to shrimp trawling, followed by Kemp's ridleys and these species are found in the U.S. and not in Malaysia.

Qestions by the United States

1. There appears to be some disagreement over whether sea turtles should be analyzed in terms of specific populations of nesting sea turtles, and whether there is sufficient evidence to conclude that certain populations of nesting sea turtles have stabilized. Leaving aside these specific populations - in particular the Malaysian Sabah Turtle Islands population - aren't there other sea turtles found in each of the Complainants' waters that are members of populations which are not yet showing signs of recovery? If such sea turtles suffer incidental mortality in shrimp trawl nets, wouldn't this contribute to the endangerment of sea turtles?

2. Mr. Guinea has performed a calculation, based on the reproductive values of sea turtles, and concludes that an annual mortality of 5,000 sea turtles nesting at Gahirmatha is "relatively minor". It was unclear to us whether this was merely an example explaining how "reproductive values" affect conservation analyses, or whether Mr. Guinea meant this as a definitive opinion that shrimp trawling off Gahirmatha is not a concern. Could the other experts also comment on this matter?

3. All of the experts have noted various causes of sea turtle mortality, including mortality on the beaches, and due to incidental mortality in shrimping and fishing operations. Does the existence of all of these threats to sea turtles make it more important, or less important, to prevent sea turtle mortality in shrimp trawl nets?

4. Do the experts agree that TEDs, when properly installed and used, reduce the mortality of sea turtles in shrimp trawl nets?

5. If all the world's shrimp trawling fleets used TEDs, would this contribute to the reduction to the threat to sea turtles? Note: We are not asking whether the use of TEDs would be sufficient to conserve sea turtles, but whether the use of TEDs would contribute to sea turtle conservation. We are also not asking the separate, sociological question of the best way (such as the adoption of regulations or the promotion of voluntary use) to encourage shrimp fishermen to use TEDs.

6. Both Dr. Poiner and Mr. Guinea mention time and area closures as a helpful approaches to sea turtle conservation. Could the experts comment on this, and in particular, address whether sea turtle mortality could also occur in areas where, and during times when, shrimp trawling is not banned. Do we have enough knowledge to identify all potential "hot spots" where sea turtles and shrimp fisheries interact?

7. Could Dr. Eckert please elaborate on his statement that seasonal migrations would not be expected in regions with warm waters?

8. Mr. Guinea noted that the adoption of TEDs by a shrimp trawling fleet would take 6-8 years. Could the experts comment on this point, particularly in light of Mr. Guinea's comment that Thailand modified existing technology to create an elegant and effective TED within a matter of months?

Questions by Thailand

1. Several of the experts have commented on the high number of turtle strandings that occur in the United States where and when TEDs are required. Do the experts agree that this evidence demonstrates any or all of the following: (a) even after years of implementation, TEDs are difficult to use properly; (b) TEDs requirements are easy to evade and many shrimpers in areas where TEDs are required believe that reasons exist to evade the requirements; (c) TEDs requirements are not easily enforced; and/or (d) mandating a TEDs requirement does not guarantee that sea turtle mortality will be reduced?

2. Although Thailand was able to quickly modify an existing TEDs design in order to receive certification from the United States, are the experts aware that Thailand was unable to develop the TEDs within the short-four-month time period provided by the U.S. measures?

3. Are the experts aware that the Thai TEDs has not been found effective in actual use?

4. Do the experts believe that four months is sufficient time to select and modify gear, train shrimper, and take all other steps necessary to implement a TEDs requirement?

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