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# The Conservation of Sea Turtles: Practices and Problems[1]

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SYNOPSIS. The various techniques in common use for conservation and restoration of depleted sea turtle populations are reviewed, namely: banning international commerce; operating artificial hatcheries, both in the natural beach environment and in styrofoam and other types of incubators; "head-starting" of hatchlings in captivity; protection of nesting females by means of beach patrols; and translocation of eggs or hatchlings to distant areas from which turtles have been extirpated or to which it is desired to introduce new colonies. The difficulties of monitoring the results of all of these techniques are discussed, and potential dangers or disadvantages of each approach are reviewed. It is concluded that, until unequivocal data become available, turtle conservationists should continue to pursue common sense or logically sound restoration programs, but should constantly re-evaluate their actions in the light of the latest available knowledge and modify or desist from current approaches as necessary.

Nearly all sea turtle biologists, sooner or later, become turtle conservationists, at least by sympathy, and frequently as a major part of their professional activities. The reasons for this metamorphosis are clear enough; those who work in the field with sea turtles are inevitably distressed as the animals they study are slaughtered, often while actually on the nesting beach. The eggs too are all too frequently raided, either by man himself or by predators that in many cases have been introduced to the system by man or allowed to form unnaturally high population densities as a result of man's tinkering with ecological balances. Moreover, while there are still places being discovered where large sea turtle populations still exist, the evidence is reasonably clear that most populations are on the retreat. The hordes of green turtles whose annual migrations to the Cayman Islands once actually assisted navigators in getting a directional fix on Grand Cayman are now not even a memory, having disappeared over a hundred years ago. The Kemp's ridley population, confined to a single nesting beach in Mexico where 40,000 individuals were seen nesting on one day in 1947, is now on the brink of extinction, with only a few hundred breeding females left. The olive ridley population in Surinam—the only population of this species in the West Atlantic—is similarly slipping out of existence before our very eyes; and sea turtles have long since ceased nesting on practically every island in the Pacific Ocean inhabited by man.

Conscientious observers of sea turtles have thus initiated many courses of action during the last two decades designed to slow the slaughter and reverse the trends towards extinction of sea turtle populations. Virtually all of these stratagems have been well-conceived, and, having personnally been involved with sea turtle conservation for fifteen years, I am convinced that they are good. But sea turtle conservation remains without a theoretical framework, and almost all techniques that have been used remain unproven and riddled with paradox. Turtle conservationists are still unsure whether it is wiser to permit exploitation of turtles themselves and to protect their eggs, or to allow a controlled egg harvest and to protect the turtles themselves—though their instincts incline most of them, including myself, to the latter. One of the main problems is that sea turtle populations appear to respond slowly and unpredictably to both stress and to conservation measures, and monitoring of a population, at the present state of the art, can only be done by counting the number of females appearing on nesting beaches. Moreover, this technique has se-

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rious shortcomings. The maturation time of sea turtles under wild conditions is still not known; it appears to be very variable, and the populations of the green turtle, at least, that have been studied do not appear to even approach the known potential growth and maturation rates observed in well-fed captive individuals. Consequently, the results of increased recruitment as manifested by increased numbers of adults arriving to nest will not be visible for an unknown but considerable number of years. Even then, the response to protection may be masked by other factors. In the case of the green turtle especially, the number of females observed to nest in a given season, even in the case of an abundant, unexploited, and presumably stable population, shows astonishing variation. Examples on record are those of Carr *et al.* (1978), who showed that an estimated 15,426 green turtles nested at Tortuguero, Costa Rica in 1978, only 5,723 in 1974, and 23,142 in 1976; even more dramatically, Limpus (1978) showed that green turtle nesting failed almost completely in Australia in 1975–76, when only 19 turtles nested at Heron Island, whereas 1,100 had nested there the season before. It will be clear from these examples that a multi-year average will need to be taken for an index of the status of the overall population to be obtained. Things are not quite so bad with the other species, however, and populations of loggerheads and ridleys, for example, appear to show relatively steady year-to-year trends, though again inexplicable "good" and "bad" years are not unknown.

In recent years a few turtle biologists have attempted some preliminary population modeling with various sea turtle populations. It is much harder to produce these models than to criticise them, and the attempts are entirely laudable. But no model yet has predictive capability and some have been based on seriously defective biological information bases, or simplistic assumptions in such parameters as maturation time that render the models more of the nature of academic exercises than interpretations of reality. Bustard (1979) provides a good, though already dated, review of the problems one encounters in attempting to derive an accurate picture of the population dynamics of any sea turtle species; such essential parameters as the sex ratio at hatching—or at maturity or the average number of nesting seasons that a given adult female will survive, remain unknown. In several publications, René Márquez of Mexico and his co-workers have attempted to derive population models for the Mexican Pacific populations of *Chelonia* and *Lepidochelys* (*e.g.*, Márquez and Doi, 1973; Márquez *et al.*, 1976, 1979). These are probably the most sophisticated models that have yet been produced for sea turtle populations; but they still rely on an extremely deficient data base, the age of maturity being derived from observations on a small number of captive individuals. Moreover, assumptions on levels of human predation are derived from tag returns, whereas spontaneous shedding of tags is known to be extensive for many sea turtle populations. It should also be recognized that in many areas tags are not returned by fishermen, either because the turtles were caught illegally, or because the tags are retained as trinkets or souvenirs.

The population of loggerhead turtles nesting on Little Cumberland Island, Georgia, U.S.A., has been extensively modeled by James Richardson and his associates; but again, conclusions are confusing. Richardson *et al.* (1978) reported on their studies of this population between 1965 and 1976, and concluded from the linear regression line of the percentage of untagged individuals found nesting each year that recruitment to the population was zero; but after only three more years of observations, these authors concluded that the same population showed a complete turn-over of breeding females over a cycle of between 5 and 6 yr!

Similar paradoxes abound in the writings of other sea turtle population experts. For example, Bjorndal (1979) plotted survivorship curves for nesting cohorts of green turtles at Tortuguero, Costa Rica from 1955 onwards, and concluded that the population was headed inexorably for extinction, with progressively decreasing

survival prospects for each cohort as the years went by. Yet the same population showed no overall decreasing trend during the years of observation, and indeed the 1976 and 1978 nesting cohorts were the two highest on record. However, these two seemingly incompatible observations may be explicable; the upturn in the population may have been a recent phenomenon resulting from the closure of the commercial exploitation of the population on the Nicaraguan feeding grounds, while the cohort survivorship curves could not be drawn for years subsequent to the early 1970s because a turtle was only deemed to have failed to survive if it was not recorded back on the nesting beach within 4 or 5 yr. Known tag shedding (leaving a detectable scar) is also a complicating factor, as is tag shedding of which no evidence is detectable (*i.e.,* complete healing of the tag wound). Turtles returning to nest outside the 5-mile area of intensive patrolling also would be unlikely to be detected, and might well be dismissed as having failed to survive. Also, the population in recent years may not be in as good shape as it might seem since the very good years of 1976 and 1978 were adjacent to poor years.

We thus see that we cannot expect to see results quickly when we attempt to protect or conserve a sea turtle population, and we are often forced into stratagems that simply seem to be commonsensical or logically bound to be good for the species rather than procedures that are "tried and true" in the strict sense. I have been party to all of these approaches, believing strongly that the absence of certainty as to the best approach is no justification for failure to act. But lest we get completely carried away by the conviction that our efforts are indeed saving sea turtles, and fail to maintain a constant critical appraisal of our efforts, it is worth reviewing the different things people try and do to save sea turtles, to judge whether these techniques are indeed as purely beneficial as we might think. I apologize in advance to anyone who is offended by this procedure; my own ox will get gored at least as severely as anyone else's.

Sea turtle conservation efforts usually fall into one of the following categories:

1) The passage of laws to prevent sea turtles from featuring in international commerce.

2) The protection of nesting female turtles from poaching by the establishment of beach patrols.

3) The movement of eggs to beach hatcheries or to artificial incubators such as styrofoam boxes, with release of hatchlings as they emerge.

4) Maintaining hatchling turtles in captivity for a period of time until they have grown sufficiently to be deemed safe from the majority of hatchling predators ("head-starting").

5). The distribution of hatchling turtles (or eggs) from a healthy breeding population to areas where the turtles have disappeared due to over-exploitation.

Scenario 1: *An international ban on the use of sea turtles and their products in trade*

This is an approach to which most turtle conservationists, including myself, have subscribed, the rationale being that if a turtle product is harder to sell because markets have been closed, prices will be lower and pressure on populations will drop. Through this argument, conservationists have been successful in getting sea turtles placed on Appendix I of the CITES Convention, listed as endangered or threatened under the US Endangered Species Act, and so on. However, a different interpretation of the potential or actual effect of such an approach has been described to me by Sr. Antonio Suarez, the world's largest industrial user of sea turtles, which we should consider carefully. I am not yet ready to espouse it, but we certainly need to face it.

Suarez agrees that, in the developed and wealthier countries, where poaching is controllable and where the income that could be generated from turtle exploitation can be denied without causing problems, total protection of sea turtles is perfectly workable. However, he warns that in countries where significant numbers of people are hungry, and where

governmental resources, especially in law enforcement, are inevitably directed strongly towards commerical areas, a flat ban may be simply a comfortable illusion that the situation is under control. Suarez regards exploitation of sea turtles as inevitable in such places—of which Mexico is his prime example—and the real question is not whether to do it but how to do it. He feels that there are definite benefits from having the highest posible price for turtle products—benefits not just for the industry, but also for the turtle populations themselves. His rationale is this: if a turtle industry is potentially highly profitable, large-scale entrepreneurs (such as himself) will move in, and, working with government (which will also now show serious interest because of the money involved), will devise a plan that will institute some rational controls on the exploitation, and which will subsidize such measures as protection of nesting beaches by such means as a tax levy on each turtle caught or sold. Suarez argues that, without worthwhile profits, the turtles will be killed wastefully and no money will be available to be turned back into management and conservation of the species.

As an extension of this argument, Suarez observes that, while it may be true that in a pure uncontrolled market situation, the more valuable we allow the species to become, the more people will devote themselves to hunting it, in Mexico the reverse may in fact be the case. A fisherman needs a certain target income in order to meet the payments on his boat, feed his family, and so on. A turtle quota that is too low to allow him to meet this target income will meet with his opposition, and he is likely to go outside the law if such a quota is insisted upon. However, Suarez argues, a fisherman may be willing to accept, say, a 50% reduction in turtle quotas if each turtle can be made twice as valuable; and, with access to high-paying international markets, it may indeed become possible to offer him the higher prices that will make a lower quota acceptable. After all, a lower quota means less work, and fishermen are not against conservation on principle; it is just that they often feel they cannot afford it, and in such places as the Pacific coast of Mexico, there may be few economic alternatives available to them apart perhaps from marijuana cultivation.

Suarez' final blow to me was his affirmation that, when the United States banned the importation of olive ridley products, the annual take of this species in Ecuador doubled promptly, as fishermen struggled to meet their target income with a reduced value for each turtle.

I do not want you to accept this argument without first attacking it as vigorously and as thoughtfully as you can. But I feel it is dangerous for us to ignore it. I personally would base my reply to Suarez on questioning the inevitability of turtle exploitation in Third World countries. Such nations as Surinam, Costa Rica, and others have demonstrated that not only wealthy countries can afford turtle protection; other nations have demonstrated strong protective policies in certain areas of their jurisdiction, and predatory policies in others—for example, Mexico protects ridleys on the Gulf Coast, and Ecuador protects all sea turtles in the Galapagos Islands, but the same nations practice rapacious exploitation of ridleys on their Pacific coasts.

These examples show that Third World countries *can* protect sea turtles, both by law and in reality; and where it seems difficult we simply have more work to do in locating economic alternatives.

Last week I was exposed to somewhat parallel arguments on the economic necessity of exploiting sea turtles while attending a South Pacific Commission meeting on sea turtle resources held in New Caledonia. Representatives from several South Pacific archipelagic nations argued vigorously that the Japanese market for hawksbill products was a fact of life, like it or not; and they definitely did like the inflated prices now being offered. They felt that the hawksbill was not demonstrably depleted in their territories (though the time span of their observations was, in one case, only one week, and in other cases not much longer), that fishermen were going to go on catching them, and they consid-

ered a ban on trade in the species an example of purist elitism that failed to recognize the economic imperatives of Third World.

We argued about this for some time, without getting anywhere, when an interesting compromise was proposed. This was that an Organization of Hawksbill Exporting Countries should be formed—OHEC, if you like—that could set up controls on exploitation, only admit to its membership those nations that had adequate and properly managed hawksbill populations, and that could in general establish controls over what was at present a totally unmanaged species. Japan has recently started making a few noises too about making some concessions toward hawksbill management, ranging from size limits on imported specimens, a ban on the import of stuffed souvenirs, and the establishment of hawksbill farms—possibly, according to present plans, in the United States Trust Territory. As the discussion developed, it was suggested that both exporting and importing countries should form an entirely closed cartel, denying market access to those countries that were not doing right for their hawksbills.

I see great potential dangers in our changing our hawksbill policy in midstream, but, as with the arguments of Antonio Suarez, we should consider everything. The OHEC proposal at least does not recommend that we open any new markets, but just try and bring existing markets under control.

One final point should be mentioned as to why a simple ban on taking or trading may not be the sole salvation of sea turtles. As we all know, one of the major pressures on the essentially non-commercial Kemp's ridley, loggerhead, and possibly also flatback turtles is the incidental capture of the animals in trawls. The ban on taking the Kemp's ridley, under any circumstances, is certainly utterly necessary in view of the critical status of the species; but, by placing a shrimp trawler in violation even if he catches a Kemp's ridley quite innocently and releases it as soon as he brings it on board, we are cutting ourselves off from a source of information that is vitally necessary to the declaration of critical marine habitat for the species. Clearly we need to establish controls or no-trawling zones in those areas where incidental capture of ridleys is most probable and demonstrable; but we have outlawed those who may provide the very data we need, on where trawlers most often catch ridleys.

Scenario 2: *Protection of nesting female turtles from exploitation by means of beach patrols*

Clearly this is one of the keys to any turtle conservation program. The nesting phase is the most vulnerable one of all, and a couple of poachers with cutlasses can, by working a nesting beach, kill every nesting female turtle in half an ocean, in the extreme case. A turtle killed on the beach early in a nesting season may have gone on to lay many hundreds of eggs, and no decent country permits the exploitation of turtles under such circumstances.

Yet again, there is something we should consider. There is no arguing that a breeding female turtle early in the nesting season is a critically important member of the species. But how important is a female at the end of the nesting season?

In the case of the green turtle—though the picture appears to be similar for other species—the great majority of tagged female turtles are never seen back on the nesting beach in subsequent years; and, having the strongest philopatry of all sea turtle species, there is no evidence that they go to other beaches. Hughes (1979) has summarized the remigration percentage for green turtles in five different populations. The highest return rate was from Surinam, where the patrol crews are likely to see every turtle nesting. Twenty-four percent of tagged female turtles were found nesting again in subsequent years. Only 11.8% remigrants were found at Tortuguero,[2] 1.8% at Ascension Island, 0.9% in Sarawak, and, on the tiny, easily and thoroughly patrolled nesting beach at Heron Island, Great Barrier Reef, only 1.0% of turtles were ever seen nesting again, even though the population is protected and not exploited.

[2] But this rate has increased in the last two seasons.

Is my conclusion that we should allow female turtles to be exploited when they have finished nesting for the season? My answer is no, but only because I do not believe the data. I am personally of the belief that a significant—usually large—proportion of Monel tags will drop off tagged turtles in the interval between nesting seasons. While some tags will stay on for a decade or two, and others that are shed will leave a permanent and detectable scar or tear at the tagged site, others, I am convinced, are shed and the scar heals over virtually undetectably, or at least is undetectable to a harried beach patroller tagging sand-covered, uncooperative turtles under cover of darkness. Some of the low return rates too are attributable to far-from-complete beach coverage by patrol personnel, as at Ascension Island, for example.

Incidentally, some nations have established turtle laws that protect the younger turtles and allow exploitation of the adults. This is the same kind of size-limit that one would apply to lobsters or oysters, and I do not know for sure whether it is good or bad. I suspect bad, because if you allow anyone to take big turtles, they are going to be tempted to take them off nesting beaches. The reverse type of size limit—protection of breeders and exploitation of immatures, such as some South Pacific nations have established following Harry Hirth's consultancy recommendations—may be much better. Young turtles are fast and circumspect and are able, to a certain degree, to look after themselves. Moreover, even turtles well past post-hatchling life are still highly susceptible to predation by such beasts as tiger sharks, and, as we have also learned in recent years, a half-grown turtle may still require several decades to reach maturity.

So I am still convinced that those individuals that have survived the vicissitudes of their long pre-maturity period, namely the breeders, are the most important ones to protect. I simply find it hard to accept that a creature that takes fifty years to mature will have one breeding season and then, in the vast majority of cases, die before it breeds again, though I suppose there are parallels to such a population model among salmon, or among hapaxanthic palm trees. But these are imperfect comparisons, because in those species we know reproduction to be a programmed one-time culmination of life, whereas with sea turtles we know that some individuals can survive for three, four, or five nesting seasons.

Scenario 3: *Establishment of hatcheries or artificial incubation of eggs in styrofoam boxes*

There is no question that, when turtle eggs are subject to total or near total predation, either by man or by feral or wild animals, something should be done. Probably the best thing to do is to control or intercept those predators in some way, so that the eggs will be left to hatch *in situ.* Other cases exist where a substantial proportion—possibly even nearly all—eggs are being lost by beach erosion, and although this may be natural, in some areas beach erosion is an unnatural artifact of the Corps of Engineers and their foreign equivalents attempting to manipulate or stabilize shorelines that would really be better off without such controls. In such cases, it may be deemed desirable to enhance the turtles' chances of reproductive success by moving the eggs to a safer place.

Hatcheries are important and in some cases vital. But the temptation should be resisted to move eggs on principle. The public relations value of a neat hatchery with rows of wire circles, each perhaps marked with small colored flags, in which the total productivity of a certain turtle beach is housed, does not outweigh the fact that in almost all cases, movement of eggs, by the techniques usually used, reduces hatching percentage from perhaps 90% to 50–70%, and if only, say, 25% of eggs were doomed to destruction by natural predators, erosion, etc., the hatchery may actually constitute a net drain on the population. Moreover, we still do not know the means by which a turtle relocates the beach of its birth when the time comes for it to nest; and until we have such knowledge we must accord particular importance to the early minutes and hours of a turtle's life, at which stage "imprinting"

*may* take place. Any deviation from natural procedures at this stage may cause a turtle to fail to re-migrate to the right place when it matures and needs to nest; and the artificial confinement of hatchlings within wire mesh cages until the sun is up, or the placement of turtles straight into the sea without letting them run down the beach, *may* short-circuit vital imprinting mechanisms. I doubt if this is the case; I doubt if turtles, that have survived so long, are that delicate; but the possibility exists.

Perhaps a more realistic possibility is that hatchery-produced turtles will not enter the sea at the optimal stage of their infantile activity frenzy, and will be subject to excessive nearshore predation; or that, by releasing hatchery turtles at a particular time and place every morning, predators may become familiar with the routine and gather accordingly. So, run a hatchery if that is the only option for getting any reasonable hatchling productivity on a given beach; but try and make the location of the hatchery one that duplicates that of a natural nest as closely as possible; and duplicate nature as closely as possible during the potentially critical early hours, from emergence at the sand surface to entering the sea. And bear in mind that a hatchery is very much a case of all of one's eggs in one basket. A hatchery, like the biblical city on a hill, cannot be hid, and will be a standing temptation to all of the usual egg predators, including man, unless it is well guarded. Localized erosion too could sweep one's entire hatchery into the sea; and nests placed close to each other in endless rows in a large hatchery may well generate sufficient metabolic heat to raise the overall temperature a few degrees above that which is natural, which, as we now know, may have profound influences upon the sex ratio of the hatchlings. Another danger is that, if a hatchery is established year after year in the same place, the residues of the eggs from seasons past may well introduce bacteria or toxic decomposition products into the new nests.

Many workers have found that hatching eggs in styrofoam boxes promotes control and protection of nests from environmental inclemencies and predators of all kinds, from ants to man. In fact, some very impressive hatching percentages have been achieved by workers using such incubators. However, as we have learned at this conference, the danger exists of severe distortion of sex ratios. Our information on this subject is still fragmentary, and we still do not know the natural hatching sex ratio for any sea turtle species; but experiments under constant-temperature conditions (and styrofoam boxes are good enough insulators for the temperature within to be nearly constant) show that only a few degrees deviation from the optimal temperature can produce an almost or completely monosexual brood.

One of the problems too with running a hatchery is that it is very difficult to monitor survivorship of the young turtles produced. Various means have been proposed or actually utilized from time to time to mark hatchlings in ways that will allow them to be identified in later life; but the difficulties of marking a 30-g animal in a way that will still be obvious when it weighs 150 kg are massive. One potential method is the insertion of permanent needle-like magnets in the body cavity, but these could only be detected in the adult by means of a large and bulky magnetometer. There is potential for biological tagging of some kind, using the animals' own immune responses to provide a permanent testable reaction; but this again will have the disadvantage of requiring elaborate mechanisms to detect. Another difficulty results simply from the enormous number of hatchlings that must be tagged in order to have a reasonable likelihood of a few being found when they grow up and nest; most authorities assume that only two or three out of a thousand hatchling sea turtles are likely to survive to maturity, so many thousands must be tagged to make an experiment worthwhile.

One technique that may be more successful than others is that of excision of a certain marginal scute, together with the unlying bone, from large series of hatchlings. If a different scute is excised each year, the year-class of the animal will be evident thereafter. This method has been used in Australia, in South Africa, and in

Florida, and there is no question that in subsequent years turtles have been caught that seemingly had been treated in this way. The problem is that one can never be sure that the injury was not inflicted by some natural cause or accident, especially when the wound heals in such a way as to blur the angular edges of the initial incision. Just last week I saw a carapace of a beautiful two-thirds grown green turtle in the Loyalty Islands. This shell had the posterior marginal on the left side missing, and it may well have been a specimen marked as a hatchling by Bustard or Limpus in Australia; but it is impossible to be sure.

Scenario 4: *Head-starting*

Because of the massive post-hatching mortality in any sea turtle population, it is natural to attempt to circumvent this loss by raising at least some of the hatchlings produced for a year or so in captivity, until they are too big to be swallowed by avian and most marine predators. It is generally recognized, though, that the technique is unproven, and the danger of short-circuiting imprinting mechanisms is even more severe than in the operation of a hatchery. There are other problems too; captive-raised turtles are likely to become "tame," and to associate the appearance of man with feeding time; when released, they may ill-advisedly swim over to boats which may be occupied by people less benign than, say, Jim McVey.

A policy question that must be addressed for any head-starting operation is that of where to release the turtles; should they be treated as "big hatchlings," and released on their natal beach, to crawl into sea and enter the same currents that they would have entered as hatchlings? Or should they be released in places where similar-sized wild individuals of the species already occur? In the absence of any good knowledge, one might guess that the first technique might favor imprinting, but the second favor survival. There are a lot of things that could go wrong, and at this stage the most sensible precaution is to submit only a small percent of the hatchlings from a given beach to the head-starting process.

I might add that, for those who are looking for support for head-starting programs, a recent paper by Travis (1979) may be of interest. Travis reported on 81 hawksbills in Samoa that were raised for just four weeks in captivity, marked with shell notches, and released. The rationale for such a short period of head-starting was not that the turtles would outgrow their predators, but that they would lose their infantile buoyancy, and, being able to dive freely, they could escape birds, start feeding straight away, and so on. Anyway, these turtles were released, 4-wk old, on 3 March 1970. On 8 June 1971, fifteen months later, no fewer than 57 of the original 81 were recaught about 17 mi west of the point of release; the turtles were reported to be still somewhat aggregated. Eight years after the release, in May 1978, Travis reports that adult turtles were once again being caught and were being offered for sale in the Apia Market; and that 11 of 17 adult turtles examined in the market showed traces of the shell-notches that had been placed on the 1-mo old turtles! Fishermen too reported that notched turtles had been caught while mating and had been seen nesting (Ross Witham, take heart!).

Does this mean that we should invest major resources in head-starting every hatchling turtle we can lay our hands on? My answer again is no, because I do not believe the data.

Scenario 5: *Release of hatchling turtles at points a long distance from the nesting beach where the eggs were laid*

This was the procedure followed by Archie Carr during the celebrated "Operation Green Turtle," in which hatchling green turtles from Tortuguero were released at a number of sites around the Caribbean at which green turtles had once been common. Carr feels that the experiment was a failure, though this conclusion may be premature—we are only now learning how slowly green turtles may grow, and the released turtles may not yet be old enough to show up on nesting

beaches. Moreover, in some of the places that the turtles were released, such as Antigua and Colombia, green turtles are once again being reported.

We are presently involved with a plan to start a breeding colony of Kemp's ridley at Padre Island, Texas, by transplanting eggs from Rancho Nuevo, three hundred miles down the coast, hatching them in Texas sand in boxes that are flown to Padre Island, and allowing the young turtles to imprint on the Padre Island seashore by being allowed to run into the sea there. The US Fish and Wildlife Service is also involved in a similar plan with the loggerhead at the Chincoteague Wildlife Refuge, in an attempt to establish a thriving colony of this species at the northern limit of its breeding range.

A question that should be asked for programs of this kind is: Even if successful, is the result desirable? If turtles are not already to be found nesting in the new locations, this may be because the habitat is unsuitable; or if the turtles were formerly there but have been exterminated by man, this same exploitation pressure may eliminate the incipient new colony. My feeling is that this type of program represents a legitimate experiment, and if the proportion of eggs or hatchlings utilized for translocation is kept low, the only objection may be that this should be a low priority for expenditure of scarce conservation funds.

## CONCLUSIONS

While little that we do is proven, even less is disproved. Taking no action to save the disappearing sea turtles is indefensible; we should continue to do what informed common sense suggests; and the greater the risk of a given conservation procedure, the fewer eggs or turtles should be subjected to such manipulation. Keep open minds; no single way will work, but between us, with our combined intelligence, knowledge, and insights, I believe we can save sea turtles from extinction.

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