

REPORT OF THE WORKING GROUP ON INGESTION

(Louis Sileo, Chair)

This report includes a summary of the information about ingested plastic presented during the technical sessions and a summary of the working group's discussions. Both are organized by taxa and deal with the prevalence and effects of ingested plastic.

SUMMARY OF TECHNICAL SESSIONS

Sixteen papers concerning ingestion of plastic were presented during the technical sessions. Five of these dealt with birds, two with fish, five with marine turtles, and four with marine mammals. There was one review paper for birds and one partial review each for fish and turtles. The majority (13) of the reports were of a descriptive or anecdotal nature. The latter are very useful for gathering baseline information for hypothesis generating and for defining and attracting attention to an emerging problem. Such anecdotal reports often show associations between observations, such as emaciation and the presence of plastics in stranded marine animal carcasses. However, with anecdotal data it is not possible to determine if such an association is coincidental or cause and effect. Only 4 of the 16 papers reported work with controlled experiments designed to test a hypothesis. There is need for more such studies designed to test hypotheses about the possible cause-effect nature of associations revealed by the anecdotal studies.

Most (14) of the papers presented information about the prevalence of ingested plastics: 9 papers introduced new data about the effects, usually harmful, of ingested plastic on individual animals. There were no data about those effects on the population dynamics of any species, nor about absorption of toxins from ingested plastics.

The nature and extent of the data presented in the technical sessions were summarized by taxa (Appendixes A to D); these summaries provided a basis for the working group's discussions. Crucial knowledge deficiencies were defined by the group and then given priority (Table 1). All priorities were reached by consensus. The areas of expertise of the scientists attending the working group sessions provided an equitable representation of the various taxa.

Future studies should have statistically adequate sampling schemes designed to test hypotheses that the prevalence is increasing or decreasing in given areas or taxa. Future studies of the effects of ingested plastics should also include statistically adequate experimental designs for testing

Table 1.--Knowledge deficiencies and informational needs arranged in order of importance.

Priority	Information needed
First	Effects on marine turtles
Second	Effects on seabirds
Third	Prevalence in marine turtles
Third	Prevalence and effects on manatees
Fourth	Effects on large fish
Fourth	Prevalence in marine mammals
Low	Effects on larval fish
Low	Prevalence in fish
Low	Prevalence in seabirds
Low	Effects on marine mammals

hypotheses. It is possible that estimates of variance from studies already completed will provide the basis for determining sample sizes required for statistical significance in future studies.

Regardless of the taxon, the same three general pathophysiological effects were proposed: (1) mechanical blockages, (2) pseudosatiety, and (3) absorption of toxins from the plastic.

RESEARCH NEEDS

First Priority

Effects of Marine Turtles

Experimental feeding studies are needed to determine (1) diagnostic criteria for interpreting the lethality or other pathologic significance of loads of ingested plastic, and (2) the entire gamut of the pathophysiology of ingested plastic in turtles.

Justification

There are relatively few data available on the prevalence or effects of ingested plastic in turtles, but those data which do exist suggest that the prevalence is high and that ingested plastic causes significant lesions and mortality. The endangered status of marine turtles justifies a prompt look at the role of plastics in mortality. Finally, it seems that a favorable cost/benefit ratio might result from dollars invested in turtle research. So little is known that a relatively small sum may produce considerable new information.

Second Priority

Effects on Seabirds

Controlled experimental work is required to determine if (1) pseudo-satiety does occur, (2) the duration of retention and erosion rates of ingested plastics, and (3) the toxicity of ingested plastics. The results of such studies will establish the need for long-term population studies of things like the postfledgling effect of plastic loading of chicks.

Justification

The available data establish that frequency of ingestion is very high in some species of seabirds and that some individuals contain very large amounts of plastic. There are few data about the effects on individual birds or populations. The few data available show no cause for alarm, but if these preliminary data are misleading, the potential deleterious effects on seabird populations could be severe. Because of the ubiquity of ingested plastic in seabirds and the as-yet-unmeasured potential for harm, it is prudent to identify the effect. Also, this group includes several threatened or endangered surface-feeding seabirds including the short-tailed albatross, *Diomedea albatrus*, which may be at risk.

Third Priority

Prevalence in Marine Turtles

The working group recommends continued monitoring of the prevalence of ingested plastic and its association with lesions. The monitoring efforts should be improved to better determine how often it actually causes harm. The working group recommends that review of the Marine Animal Stranding network be conducted to determine if the network's activities could be enhanced by standardizing necropsy protocols and by including collection of data about ingested plastics. Adequate diagnostic pathology services should be provided for the biologists in the Network. Even though the anecdotal data generated by monitoring programs cannot prove cause-effect relationships, they do provide useful information data bases.

Justification

This is the same as for first priority. Also, the Marine Animal Stranding Network is already in place; it would seem cost efficient to strengthen the program and orient it to collect and analyze data on ingested plastics.

Prevalence and Effects in Manatees

The data presented in the technical session suggested that plastic ingestion is common and was considered the cause of death of one manatee. It is recommended that carcasses found through the Marine Animal Stranding

Network be examined to obtain as much information as possible from each animal recovered.

Justification

There are no data about the impact of ingested plastic on the manatee population. Since this is a remnant population near extinction, any avoidable source of death is unacceptable.

Fourth Priority

Effects on Fishes

The working group recommends that laboratory work be done first with large fish to determine under what conditions they ingest plastics and to determine further the effect of the plastics. For example, will ingested plastic be retained for long periods and cause gastrointestinal tract blockages? Will it induce pseudosatiety, or release toxic chemicals?

Justification

Potential losses to the commercial and recreational fisheries may occur if ingested plastics impair the health of large fish. The working group assigned fourth priority to this issue because field and laboratory evidence available to date are equivocal, and as yet there is no evidence of a significant problem.

Prevalence in Marine Mammals

The working group recommends that monitoring of ingested plastics in stranded marine mammals be continued and improved as much as possible, taking advantage of the Marine Animal Stranding Network.

Justification

The working group generally agreed that available data suggest ingested plastics are a lesser problem in marine mammals and that there are no apparent reasons to elevate this issue to a higher priority at this time. It was also stated that laboratory work might better elucidate the consequences of ingested plastics, but that laboratory work with marine mammals is impractical because of logistics and legal complications.

Low Priority

Low priority issues are not unimportant, but they are less pressing than those above.

Effects on Larval Fish

The working group recommends that additional laboratory feeding experiments be done with larval fish to determine if ingested microparticles reduce growth rates.

Prevalence in Fish

The working group recommends that a specific study be designed to look for plastics in the gastrointestinal tract of large, free-ranging fish and for indications that it causes harm. This might be accomplished by alerting and educating fisheries biologists about the issue. This work could be done in conjunction with other on-going studies.

Prevalence in Seabirds

The working group recommends continued monitoring for benefits accrued (public awareness, time-order trends), but suspects that monitoring will continue without specific, directed guidance.

Effects on Marine Mammals

Laboratory studies of the effects of ingested plastic would provide useful data, but the group generally agreed that such studies are impractical for logistical and legal reasons.

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APPENDIX A

Summary of information from five reports on the prevalence and effect of ingested plastics in seabirds.

Prevalence

Many previously unpublished data were presented at the technical sessions. Ingested plastics are present in many species and the prevalence is high in some species. Prevalence between species is influenced by feeding behavior, feeding location, season, year, resident or migrant status, and whether or not chicks are fed by regurgitation.

Effect of Ingested Plastic on Individual Seabirds

Some die from the lesions caused by impactions. Fledging weights of one species were reduced in chicks having high volumes of ingested plastic.

Effect of Ingested Plastic on Seabird Populations

There are no data available.

APPENDIX B

Summary of information from two reports on the prevalence and effect of ingested plastics in fish.

Prevalence

Ingestion does occur, but the information available suggests that this is uncommon. In one study, 20 of 3,000 larval fish contained ingested plastics. Nothing is known of the prevalence in large fish. In one study, most lancetfish contained one or more pieces of plastic.

Effect on Individual Fish

There is no clear evidence of an effect. In one study, larval fish ate 500 μ spherules, but there was no detectable short-term effect. No data are available about the effect on large fish.

Effect on Fish Populations

No data were presented.

APPENDIX C

Summary of information from five reports on the prevalence and effect of ingested plastics in marine turtles.

Prevalence

The few data available suggest the prevalence is high. In one study, 8 of 15 young pelagic turtles carcasses had intestinal compactions containing hundreds of pieces of debris. There were 3,000 pieces of plastic in 1 compaction. These compactions were the suspected cause of death. In another study, 60 of 111 beach-washed turtle carcasses contained intestinal debris, and 4 died from the effects. Yet another study reported debris in 12 of 168 stranded turtles; 5 of which had blocked pyloruses. Plastic bags or sheeting seemed to be the offenders.

Effect on Individual Turtles

Impactions can kill turtles. The few available data suggest that this is potentially a serious problem. Laboratory studies suggest that low doses of plastic have no effect.

Effect on Turtle Populations

There is no information available.

APPENDIX D

Summary of information from four reports on the prevalence and effect on ingested plastics in marine mammals.

Prevalence

The data are not completely clear. One report suggested the prevalence is low, others that it is high. Plastic was found in 15% of 63 dolphins and in 6 of 82 whales in one study. Another study reported that plastic debris was present in 67% of stranded whales. This study also reported debris in the stomachs of 23 of 86 Baird's beaked whales examined; 30% of this ingested debris was plastic.

Effects on Individual Marine Mammals

Data from both wild and aquarium specimens show that ingested debris can kill cetaceans.

Effects on Marine Mammal Populations

There are no data available.
