ADDITIONAL NOTES ON THE IMPACTS OF THE SUBMARINE TAILINGS PLACEMENT (STP) MINING WASTE DISPOSAL PROCEDURE ON INDONESIAN CEPHALOPODS.

Dr Mark Norman
Cephalopod Ecology Researcher
Councillor of Cephalopod International Advisory Council
University of Melbourne

The Northern Sulawesi region is home to a unique and extremely diverse marine flora and fauna, found nowhere else in the world. Sulawesi is situated at the core of the highest marine bio-diversity found anywhere on the planet. It is the dramatic and diverse marine life of this region which draws tourists, researchers and film crews from around the world to experience these unique ecosystems. They are too valuable to jeopardise with the high-risk mining practice proposed for the region.

I undertake research into the composition, biology, behaviour, evolution and fisheries of cephalopods (octopuses, squids, cuttlefishes and nautiluses) and I have visited the Northern Sulawesi region several times.

I fully support the STP Letter of Concern and have included an outline of the potential biological and socio-ecomonic effects on the diverse and commercially important cephalopods populations of Northern Sulawesi by the proposed submarine tailings placements.

My comments under the specific points mentioned by the STP Letter of Concern are:

WASTE AND TOXINS WILL ABSORBED BY MARINE CREATURES IN THIS REGION.

- **Accumulation of toxic chemicals:**

  Octopus, squids and their relatives are top level predators which accumulate toxins absorbed by their crustacean, mollusc and fish prey. Accumulation of heavy metals in cephalopods these animals is well documented (e.g. Miramand & Guary, 1980) and **these creatures will act as biological vectors in the transport of these contaminants to surface and coastal waters.**

- **Octopuses, squids and their relatives do not observe minor thermoclines as boundaries to movement (such as that proposed at less than 80 m):**

  Depth range data for octopuses from the region shows that the major faunal change (and thermocline) occurs at the edges of the continental slopes, around 200 m (Norman *et al.*, 1997), with many species showing vertical ranges from intertidal habitats to this 200 m boundary (Norman, 1993, Norman and Sweeney, 1997).

- **High mobility of adult octopuses and squids on a daily basis:**

  Itami (1964) undertook a huge octopus mark-recapture survey off Japan and found that these benthic animals covered large distances in adult stage (in two individuals: 21 km in 3 days and 50 km in 40 days). These results only refer to the benthic octopuses. In the case of the highly mobile squids, the scale of daily movements is likely to be much larger.

Squids show both significant vertical and horizontal mobility, feeding both up and down the water column as well as on bottom-living prey.

- **Vertical shifts of cephalopod species through their life cycles:**

  Many octopuses, squids and cuttlefishes have juveniles with distinctly different life histories than that of the adult. Many shallow-water species start their lives in deeper waters, migrating to shallow coastal waters as they develop. These animals are fast growing with short life cycles (typically a year or less). These animals can act as an additional vector for movement of toxic wastes across thermoclines and into shallower waters.

HIGH ECONOMIC RISK TO LOCAL AND EXPORT FISHERIES.

- **Death of valued fishery species:**

  Chemical contamination may directly kill off key cephalopod species, many of which are highly prized for human consumption and export (particularly squids of the family Loliginidae).

- **Impacts on food chains:**

  Unforeseen impacts of chemical contamination of other predators or prey may have a significant impact on food chains and influence fisheries returns at both a local subsistence and commercial fisheries level.

- **Loss of export fisheries:**

  Both genuinely contaminated seafoods and market perceptions of potential contamination are sufficient to damage or threaten valuable export fisheries from the region.

INCREASED HUMAN HEALTH RISKS.

- **Human poisoning:**

  One of the largest concerns is the direct health risk of local populations consuming contaminated seafoods. The high mobility of squids and octopuses (see above) and their prevalence and high value in local markets (M. Norman, pers. obs.) makes it highly likely that contaminated animals will be consumed on a regular basis in communities adjacent to proposed STP sites.

THREATS TO DEEPER WATER PELAGIC AND BENTHIC ECOSYSTEMS.

- **Inherent value:**

  Ecosystems at the level of the proposed tailings release (and the associated benthic and pelagic creatures at these depths) are similarly unique and require protection in their own right.

- **Impacts on deeper ecosystems:**

  Sinkage of contaminants into even deeper waters is likely to occur with unknown consequences. Developmental and breeding migrations of various marine fauna between shallow and deepwater habitats may also act as a vector for transport of contaminants. The relationships between the creatures of shelf and deeper water habitats are still largely unexplored. Recent studies (e.g Kahn, 1999; Kahn, 2000) have shown that the region does have a relatively high diversity of coastal and oceanic cetaceans (whales and dolphins). Most of these species feed on squid and are especially vulnerable to chemical pollutants (Simmonds and Hutchinson, 1996).

RISK OF ACCIDENTAL SPILLAGES IN COASTAL WATERS.

- **Industrial accidents:**

  The risk of accidental release/spillage in coastal waters seriously threatens all the environmental and subsistence/fisheries values discussed above.

In summary, the combined risks of this questionable mining practice (for environment, human health and economy) are too high to warrant consideration.

For more information contact the author

Dr Mark Norman
Principal Researcher and Councillor of Cephalopod
International Advisory Council
Zoology Department
University of Melbourne
Parkville, Vic 3052 Australia
E-mail: m.norman@zoology.unimelb.edu.au
or

Benjamin Kahn, M.Sc.
Principal Researcher
Indonesia Oceanic Cetacean Program
APEX Environmental
PO Box 59 Clifton Beach - Cairns
4879 Qld Australia
E-mail:bkahn@apex-environmental.com

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