TOOL 7: RESPONSIBLE PROVISIONING

Provisioning is a highly controversial and potentially harmful practice. Where natural encounters are likely without any form of attractant, it is best not to use one. Provisioning should only be undertaken in exceptional circumstances/locations and in a responsible way.

Because the long-term impacts of provisioning are unknown, a precautionary approach is recommended to avoid unexpected ecological, safety, and economic consequences. Possible management actions include:

- Controlling the amount and type of bait an operator can use over a given time period; and
- Using a permitting system to limit the number of operators allowed to provision sharks or rays.[85]

If you do use provisioning, you should have a responsible provisioning plan in place. It's wise to keep up to date with the latest research and be prepared to adapt the plan when change is needed.

A responsible provisioning plan needs to:

- Contain information about the species being provisioned – the name and any significant biological or ecological traits, e.g. size, what it eats and how often, and whether it's resident to the area year-round or seasonally. Identify risks based on the latest science associated with provisioning of that species or similar species. These risks can be environmental, social, or economic. These could include:
  - Safety issues for humans and the animals
  - Behavioral, ecological or physiological impacts to the animals
  - Changes to the local ecosystem, e.g. changes to habitats, introduction of different species or changes in the types of species found
  - Impacts on the operator's social license, e.g. community concerns that feeding will cause 'shark attacks'.
- Rank those risks according to impact and likelihood of the risk occurring.
- Identify measures that can be taken to reduce the risks identified.

The following recommendations can help you prepare your responsible provisioning plan and reduce potential risks. Note that different species of sharks can react in different ways.

RECOMMENDATIONS

1. Use a combination of local and natural foods that reflects the natural diet of the animals.
2. **Control**
   a. the amount of food for each shark/ray per day.
   b. the provisioning to once a day and consider varying the time of feeding. Note – sharks that are attracted to an aggregation site for tourism may remain in close vicinity, which could potentially put extra pressure on that area from hungry sharks.[86] In this case it is more important to limit feeding events, not the amount each shark receives.
   c. the number of provisioning days (i.e. have days off) to reduce impacts that lead to increased residency or changes in natural behavior of sharks and rays at a site.
3. Deliver food in the most natural way (e.g. lying on the bottom or under reef patches at a distance from humans).
4. Give small amounts of food at once in order to avoid competition and aggression between sharks on large pieces.
5. Feeding (especially hand feeding) is much more unsafe (in diving safety terms) than chumming or baiting.
6. Limit the number of people feeding – preferably only the dive supervisor, with everyone kneeling on the seabed. For sharks, the guests should be behind or against some structure or have lookouts (staff) behind them for sharks that may enter from behind.
7. Don't touch the sharks or rays, and ensure they have ample space in which to maneuver – although feeders may have to push animals away from guests.
8. Feed away from the vessel to prevent propeller scars and boat anticipation behavior.
9. Undertake provisioning of large predators well away from population and tourism centers.
10. Have an accident and emergency strategy and staff trained in its application.
11. Get involved in provisioning research.

TOOL 7: RESPONSIBLE PROVISIONING

RESEARCH

While the long-term impacts of provisioning remain uncertain, evidence is emerging of negative impacts. The following table summarizes some of the latest studies.

LOCATION	ACTION	RESULTS	POTENTIAL EFFECTS	STUDY REFERENCE
STINGRAY CITY SANDBAR, CAYMAN ISLANDS [87]	Feeding stingrays with squid.	Rays being lifted entirely out of water. Rays displaying shoaling behavior, skin abrasions from handling, altered feeding habits. Buzzing and bumping divers for food and displaying hunger and aggression when boat isn't able to access site.	Dependence on provisioning, limited natural foraging.	*Shackley, M. (1998). 'Stingray City' – managing the impact of underwater tourism in the Cayman Islands. Journal of Sustainable Tourism, 6(4), 328-338.*
STINGRAY CITY SANDBAR, CAYMAN ISLANDS [88]	Feeding stingrays with squid.	Disproportionate amount of fatty acid, essential fatty acids and amino acids.	Diet-related impacts on growth, reproduction, survival and overall health.	*Semeniuk, C. A., Speers-Roesch, B., & Rothley, K. D. (2007). Using fatty-acid profile analysis as an ecologic indicator in the management of tourist impacts on marine wildlife: a case of stingray-feeding in the Caribbean. Environmental Management, 40(4), 665-677.*
STINGRAY CITY SANDBAR, CAYMAN ISLANDS [89]	Feeding stingrays with squid.	Overall lower body condition of fed stingrays including injuries by boat and people, higher load of ecto-parasites, conspecific bites, reversed diel/nocturnal pattern, gregarious living and atypical densities.	Decreased long-term fitness.	*Semeniuk, C. A., & Rothley, K. D. (2008). Costs of group-living for a normally solitary forager: effects of provisioning tourism on southern stingrays Dasyatis americana. Marine Ecology-Progress Series, 357, 271.*
STINGRAY CITY SANDBAR, CAYMAN ISLANDS [90]	Feeding stingrays with squid.	Hematological differences in leukocrit, serum proteins and antioxidant potential indicating an attenuated defense system.	Indicates dietary inadequacies, immune deficiency, disease and overall lower body condition.	*Semeniuk, C. A., Bourgeon, S., Smith, S. L., & Rothley, K. D. (2009). Hematological differences between stingrays at tourist and non-visited sites suggest physiological costs of wildlife tourism. Biological Conservation, 142(8), 1818-1829.*

TOOL 7: RESPONSIBLE PROVISIONING

LOCATION	ACTION	RESULTS	POTENTIAL EFFECTS	STUDY REFERENCE
STINGRAY CITY SANDBAR, CAYMAN ISLANDS [91]	Feeding stingrays	Supplemental feeding has strikingly altered movement behavior and spatial distribution of the stingrays, and generated a high density of animals at the Stingray City Sandbar.	There could be downstream fitness costs for individuals and potentially broader ecosystem effects.	*Corcoran MJ, Wetherbee BM, Shivji MS, Potenski MD, Chapman DD, et al. (2013) Supplemental feeding for ecotourism reverses diel activity and alters movement patterns and spatial distribution of the southern stingray, Dasyatis americana. PLoS ONE 8: e59235*
HAMELIN BAY, WESTERN AUSTRALIA [92]	Feeding stingrays at unsupervised site.	Aggressive behavior between rays and other animals. Strong inter- and intra-specific hierarchy. Fed on average 12.5kg/day.	Concerns regarding stingray safety and risky behaviors by humans.	*Newsome, D., Lewis, A., & Moncrieff, D. (2004). Impacts and risks associated with developing, but unsupervised, stingray tourism at Hamelin Bay, Western Australia. International Journal of Tourism Research, 6(5), 305-323.*
BORA-BORA ISLAND, FRENCH POLYNESIA [93]	Feeding sicklefin lemon sharks.	Increased risk of accidental bites on divers linked to hand-feeding practices.	Suggest to avoid hand-feeding in implemented practices of provisioning.	*Clua, E.E., Torrente, F. (2015) Determining the Role of Hand Feeding Practices in Accidental Shark Bites on Scuba Divers. Journal of Forensic Science & Criminology, 3(5), 502.*
MOOREA ISLAND, FRENCH POLYNESIA [94]	Feeding pink whiprays.	Individual variation in frequentation rates at feeding sites. Anticipation behavior, daily bi-modal behavior.	Potential long-term effects of feeding on behavior, reproduction and health.	*Gaspar, C., Chateau, O., & Galzin, R. (2008). Feeding sites frequentation by the pink whipray Himantura fai in Moorea (French Polynesia) as determined by acoustic telemetry. Cybium, 32(2), 153-164.*

TOOL 7: RESPONSIBLE PROVISIONING

LOCATION	ACTION	RESULTS	POTENTIAL EFFECTS	STUDY REFERENCE
SHARK REEF MARINE RESERVE, FIJI [95,96]	Feeding bull sharks.	Intraspecific variation in residency and site fidelity.	Long-term movements appear unaffected	*Brunnschweiler, J. M., & Barnett, A. (2013). Opportunistic visitors: long-term behavioral response of bull sharks to food provisioning in Fiji. PloS One, 8(3), e58522.* *Brunnschweiler, J.M., & Baensch, H. (2011) Seasonal and long-term changes in relative abundance of bull sharks from a tourist shark feeding site in Fiji. PLoS ONE, 6(1), e16597*
SHARK REEF MARINE RESERVE, FIJI [97]	Multi-species shark feeding site.	Numbers of bull sharks increased over years; majority are large (>2m). Competitive exclusion among species.	Changes in natural community composition, richness and/or predation pressure unclear.	*Brunnschweiler, J. M., Abrantes, K. G., & Barnett, A. (2014). Long-term changes in species composition and relative abundances of sharks at a provisioning site. PLoS ONE, 9(1), e86682. doi:10.1371/journal.pone.0086682*
NEPTUNE ISLANDS, SOUTH AUSTRALIA [98]	Cage-diving with white sharks using attractants.	Shark numbers have increased. Increases in residency. Changes in diel patterns.	Broad-scale movement not affected. Concern that sharks miss opportunities to hunt pinnipeds, making provisioning energetically costly.	*Bruce, B.D., & Bradford, R.W. (2013). The effects of shark cage-diving operations on the behavior and movements of white sharks, Carcharodon carcharias, at the Neptune Islands, South Australia. Marine Biology, 160, 889–907.*
RED SEA, OFF JEDDAH, SAUDI ARABIA [99]	Feeding female silky sharks at two reefs.	Visit reefs irrespective of feeding. May stay longer if fed.	Modifications to local habitat use. No marked seasonal trends, potential to affect population dynamics given the sex bias.	*Clarke, C., Lea, J.S.E., & Ormond, R.F.G. (2011). Reef-use and residency patterns of a baited population of silky sharks, Carcharhinus falciformis, in the Red Sea. Marine and Freshwater Research, 62(6), 668-675.*

TOOL 7: RESPONSIBLE PROVISIONING

LOCATION	ACTION	RESULTS	POTENTIAL EFFECTS	STUDY REFERENCE
SEAL ISLAND, SOUTH AFRICA [100]	Using a seal decoy and chum to attract white sharks.	Change in swimming depth. Majority of sharks showed little interest.	The sub-set of sharks that were attracted showed a decreasing response over time. Unlikely to have behavioral impacts.	*Laroche, R., Kock, A.A., Dill, L.M., & Oosthuizen, W. (2007). Effects of provisioning ecotourism activity on the behavior of white sharks Carcharodon carcharias. Marine Ecology Progress Series, 338, 199-209.*
NEW PROVIDENCE, BAHAMAS [101]	Feeding Caribbean reef sharks.	A few sharks monopolized majority of bait, displaying a social hierarchy. These sharks had a higher N level in tissues, thought to be attributed to high-trophic level meals (grouper carcasses).	No evidence of behavioral impacts, changes to seasonal movements or degrees of residency.	*Maljković, A., & Côté, I.M. (2011). Effects of tourism-related provisioning on the trophic signatures and movement patterns of an apex predator, the Caribbean reef shark. Biological Conservation, 144(2), 859-865*
OAHU, HAWAII [102]	Multi-species cage-diving using fish scraps.	Galapagos, sandbar and tiger sharks all displayed seasonal and long-term residency changes. Social hierarchies. Only sexually mature male sandbar sharks. Both mature and immature Galapagos sharks.	No changes to long-term movements. Sandbar sharks are most likely being encountered during breeding migrations.	*Bruce, B.D., & Bradford, R.W. (2013). The effects of shark cage-diving operations on the behavior and movements of white sharks, Carcharodon carcharias, at the Neptune Islands, South Australia. Marine Biology, 160, 889–907.*
CEBU, PHILIPPINES [103]	Feeding whale sharks.	Extended residency of fed individuals, 44.9 days vs. 22.4 days. Propeller scars observed in 47% of individuals.	Changes in local habitat use. Lower body condition, risk of injury.	*Araujo, G., Lucey, A., Labaja, J., So, C.L., Snow, S., & Ponzo, A. (2014). Population structure and residency patterns of whale sharks, Rhincodon typus, at a provisioning site in Cebu, Philippines. PeerJ, 2, e543.*

TOOL 7: RESPONSIBLE PROVISIONING

LOCATION	ACTION	RESULTS	POTENTIAL EFFECTS	STUDY REFERENCE
MOOREA ISLAND, FRENCH POLYNESIA [104]	Impacts to fish populations at shark feeding site.	Long-term shark feeding does have some parasitological impact in grouper and snapper species.	Does not seem to affect health of fish.	*Vignon, M., Sasal, P., Johnson, R. L., & Galzin, R. (2010). Impact of shark-feeding tourism on surrounding fish populations off Moorea Island (French Polynesia). Marine and Freshwater Research, 61(2), 163-169.*
MOOREA ISLAND, FRENCH POLYNESIA [105, 106]	Feeding sicklefin lemon sharks.	Increased intra-specific aggression. Increased residency. Gregarious feeding though naturally solitary. Increased accidental bites to humans.	Suggest potential inbreeding risks due to increased residency (although this was discredited in a later study). Continued aggression towards people.	*Clua, E., Buray, N., Legendre, P., Mourier, J., & Planes, S. (2010). Behavioral response of sicklefin lemon sharks Negaprion acutidens to underwater feeding for ecotourism purposes. Marine Ecology Progress Series, 414, 257-266* *Mourier, J., Buray, N., Schultz, J. K., Clua, E., & Planes, S. (2013). Genetic network and breeding patterns of a sicklefin lemon shark (Negaprion acutidens) population in the Society Islands, French Polynesia. PLoS One, 8(8).*
OSPREY REEF, CORAL SEA, AUSTRALIA [107]	Feeding white-tip reef sharks.	Anticipation behavior. When boats were present these inherently nocturnal sharks exhibited long periods of vertical activity during the day.	Potential effects on energy budgets, metabolism, overall health and fitness.	*Fitzpatrick, R., Abrantes, K.G., Seymour, J., & Barnett, A. (2011). Variation in depth of whitetip reef sharks: does provisioning ecotourism change their behavior? Coral Reefs, 30(3), 569-577.*